# Module C

## *Support Services Area*

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# MODULE C

## *SUPPORT SERVICES AREA*

This module is an attachment to Volume 1 of the Resource Conservation and recovery Act (RCRA) Facility Investigation (RFI) Report for Lawrence Berkeley National Laboratory (LBNL). Volume 1 presents an overview of the RFI as it pertains to LBNL as a whole and contains information on the overall characteristics of the site (i.e., physical layout, geology, hydrogeology, potential contaminants, contaminant migration pathways, and potential receptors). Volume 1 is accompanied by four modules that correspond to specific areas of LBNL (Figure C-2).

A. Bevalac Area
B. Old Town Area
C. Support Services Area (this module)
D. Outlying Areas.

Each of the modules contain the following area-specific information for RCRA Facility Investigation (RFI) activities conducted since the Phase II Progress Report (LBNL, 1995k):

- the physical characteristics of the module area, including geology and hydrogeology
- a description of Solid Waste Management Units (SWMUs), Areas of Concern (AOCs), and other areas that were investigated
- results of contaminant characterization activities that were completed
- Interim Corrective Measures (ICMs) that were implemented
- potential and identified sources of contamination
- contaminant migration pathways.

For reporting purposes, the RCRA Facility Assessment (RFA) subdivided LBNL into 15 study areas (LBNL, 1992d). The Support Services Area (Figure C-3) is composed of RCRA Facility Assessment (RFA) Study Areas 3, 4, and 5. Table C1-1 lists the SWMUs and AOCs that have been identified in the Support Services Area and indicates which of those are discussed in this module. The SWMUs and AOCs discussed in this module include only those where

characterization or Interim Corrective Measures (ICM) activities have been conducted since July 1, 1995, when the Draft Final RCRA Facility Investigation Phase II Progress Report (LBNL, 1995k) was prepared. The table also lists two other areas (construction sites) included in this module that were investigated after July 1, 1995. RFI activities conducted at SWMUs and AOCs prior to July 1, 1995 are documented in the Draft Final RFI Phase I or Phase II Progress Reports (LBNL, 1994l and LBNL, 1995k).

The SWMUs and AOCs discussed in this module are associated with laboratory support services, including fabrication shop and motor pool/fuel storage operations. The locations of those units are shown on Figure C-3. A separate report for the National Tritium Labeling Facility (NTLF) (SWMU 3-7) will be submitted to the United States Department of Energy (DOE) when investigations at that unit have been completed. The report will also be distributed to the RCRA oversight agencies. Radiological units are not included under RCRA but are being reviewed by DOE using a similar process.

## C1 SUPPORT SERVICES AREA DESCRIPTION

The Support Services Area includes three major subareas.

- The Building 69/75 complex contains the central receiving area for LBNL and the Building 75/69A Former Hazardous Waste Handling and Storage Facility (HWHF). The central receiving area started operations in the mid-1960s and the former HWHF in 1982. The California Environmental Protection Agency (CAL-EPA) Department of Toxic Substances Control (DTSC) approved closure certification of the former HWHF on July 8, 1998.
- The Building 76/78 Area houses the motor pool and various fabrication, construction, and maintenance shops that began operation in 1964.
- The Building 77/79 area houses fabrication and maintenance shops, including a plating shop. Operations began in this area in 1964.

In addition, several other facilities are present within the area, including the Grizzly Electrical Substation and the Maintenance Building (Building 31).

# C2 PHYSIOGRAPHY, GEOLOGY, AND HYDROGEOLOGY

## *C2.1 Summary of LBNL Site Physical Characteristics*

A detailed discussion of the overall physiography, geology and hydrogeology of LBNL is given in Volume 1 of this report and summarized below:

LBNL is located on the moderate to steep west- and south-facing slopes of the Oakland-Berkeley Hills, with surface elevations ranging from approximately 500 to 1000 feet above mean sea level (msl). The physiography is dominated by a steep southwest-facing slope that has been modified by erosion of several steep stream canyons, by mass movement resulting from landslides and soil creep, and by cut-and-fill operations associated with construction of LBNL facilities.

Bedrock at LBNL consists primarily of Cretaceous and Miocene sedimentary and volcanic units, as shown on the summary stratigraphic column (Figure C2.1-1). These units form a northeast-dipping, faulted homocline, as shown on the bedrock geologic map (Figure C2.1-2). The homocline is composed of the following three rock units:

- Cretaceous marine mudstones, shales, and sandstones of the Great Valley Group
- Miocene nonmarine sandstones, mudstones and conglomerates of the Orinda Formation
- Miocene andesitic volcanic and volcaniclastic rocks of the Moraga Formation.

Strata of the Cretaceous Great Valley Group form the structurally lowest portion of the homocline and underlie the southern and western slopes of LBNL. The Orinda Formation lies structurally above the Great Valley Group along a fault contact that dips at a shallow angle to the northeast. The Moraga Formation overlies the Orinda Formation along a conformable contact.

Numerous isolated masses of Moraga Formation volcanic rock underlie the developed portions of LBNL at lower elevations than the main Moraga Formation outcrop belt. The rock at the contact between these masses and the Orinda Formation is often composed of slickensided, volcaniclastic/sedimentaclastic rocks that have been informally denoted as the "Mixed Unit".

These masses are interpreted to be paleolandslide deposits that are younger than the Moraga Formation but older than historically active landslides at LBNL.

In the easternmost portion of LBNL, the homocline is truncated by the north-striking Wildcat and East Canyon faults. The area east of these faults is underlain by marine sedimentary rocks of the Miocene Claremont Formation and the Miocene San Pablo Group (?). At the western LBNL property boundary, the homocline is truncated by the north to northwest striking Hayward Fault, a regionally extensive, active, right-lateral strike-slip fault. Rocks west of the Hayward fault consist of the Jurassic to Cretaceous Franciscan Complex.

A surficial geologic map of LBNL is shown on Figure C2.1-3. The soil is typically a silty clay less than 2-feet thick. Alluvium is present in some of the creek and stream beds. Colluvial deposits, generally less than 20-feet thick, have developed along the bases of slopes and in hillside concavities as a result of mass wasting processes. At least one major, and several minor, landslides are present on the steeper slopes at LBNL; some have moved since construction of LBNL facilities. These landslide deposits differ from the paleolandslide deposits described above in that they have evidence of historic movement.

Groundwater flow directions generally follow the slope of the surface topography. However, at some locations flow directions deviate due to contrasts in subsurface hydraulic conductivity or artificial drainage features such as building subdrains, subhorizontal hillside drains (hydraugers), and slope stability wells. Hydraulic conductivity testing and groundwater well yields show that the Moraga Formation is relatively permeable, and constitutes the main water-bearing unit at LBNL. In contrast, the underlying Orinda Formation is relatively impermeable. Measured hydraulic conductivities in the other units at LBNL are generally intermediate between these two formations.

## *C2.2 Support Services Area Physiography and Surface Water Hydrology*

Prior to development of the site, the steep, generally south-facing slopes of the Support Services Area were bisected by Chicken Creek Canyon, a major north-south-trending drainage course. A map of the pre-construction topography (Figure C2.2-1) shows that two main

tributaries occupied the area between the current locations of Buildings 69, 75, and 77. These tributaries and a third tributary to the east formerly passed beneath the current location of Building 77 and merged to form the main channel of Chicken Creek below Building 77.

These drainages were extensively altered during development of the Support Services Area. Grading activities created two principal flat sites for buildings and parking: the upper site comprises the Building 69/75 complex; the lower site comprises the Building 42/77/79 complex. Both sites required cuts up to 30 feet deep and fills up to 65 feet and resulted in filling of the upper reaches of the Chicken Creek tributaries (Figure C2.2-2).

The Support Services Area lies within the Strawberry Canyon watershed (Figure C2.2-3). The main drainage in this watershed is Strawberry Creek (in Strawberry Canyon), which receives water from Chicken Creek, the main drainage within the Support Services Area (Figure C2.2-4). Runoff to surface water in the Support Services Area is derived from several sources, including paved and unpaved areas, and the subhorizontal hillside drains (hydraugers) that lie beneath Buildings 31 and 72 and extend into the hillsides above Buildings 69, 75, and 77 (Figure C2.2-5). Surface water runoff in the developed portion of the Support Services Area is directed into storm sewers to Chicken Creek (Figure C2.2-4); runoff in the remainder of the area flows into either Chicken Creek or No-Name Creek (section C.4.5). Water from these creeks flows into a storm sewer that lies along the former course of Strawberry Creek near the southern property boundary, and ultimately discharges to San Francisco Bay.

## *C2.3 Support Services Area Geology*

As shown on the bedrock geologic map (Figure C2.3-1) and on cross sections A-A' through G-G' (Figures C2.3-2 through C2.3-8), three main bedrock units underlie the Support Services Area. Marine mudstones, sandstones, and shales of the Great Valley Group lie on the undeveloped lower slopes to the south. These strata are overlain to the north by nonmarine siltstones and fine-grained sandstones of the Orinda Formation. Over much of the northern and northeastern part of the Support Services Area, the Orinda Formation is overlain by rocks of the Moraga Formation, consisting primarily of interbedded massive andesite, volcanic breccia, and

basalt to the northeast; and massive andesite, volcanic breccia, and volcaniclastic sandstones and siltstones to the northwest.

Exposures of the contact between the Great Valley Group and the overlying Orinda Formation are relatively poor in the Support Services Area. However, field relationships observed in the adjacent Old Town Area suggest that the contact is an (inactive) fault that dips at relatively low angles to bedding in the underlying and overlying units.

The contact between the Moraga and Orinda Formations dips gently to moderately east and northeast on the east side of the area and gently west and northwest on the northwest side of the area (Holland and Wollenberg, 1992). The contact appears to be concordant to bedding over most of the area, but is offset downslope in the area east of Building 77. This offset suggests that the rocks east of Building 77 are displaced. They are therefore interpreted to represent a landslide deposit, as shown on Figure C2.3-1, although exposures are insufficient to verify this interpretation.

Colluvium greater than 10 feet thick underlies most of the Building 69/75 complex and much of the area from Building 76 to Building 25, extending downslope to Building 42. Colluvial deposits also underlie Centennial Drive and the slope between the east end of Building 77 and Centennial Drive.

Hillside cuts and canyon filling activities resulted in placement of artificial fill up to 65 feet thick within the Support Services Area, as shown on Cross Sections A-A' through G-G' (Figure C2.3-2 through C2.3-8). Several boring logs from the Building 69/75 area record abundant organic debris (e.g. eucalyptus trees) at the base of the fill.

## *C2.4 Support Services Area Hydrogeology*

Shallow groundwater in the Support Services Area is primarily present in the Orinda Formation. In some areas, the water table extends into the lower part of the surficial units (i.e., alluvium, colluvium, and artificial fill). At these locations, the water table lies a short distance above the contact between the bedrock and surficial units, as shown on cross section A-A' (Figure C2.3-2)

The structurally lowest units throughout most of the Support Services Area are the Great Valley Group and the Orinda Formation (Figure C2.3-1). However, the Great Valley Group only crops out on the lowermost slopes of the area and is overlain by several hundred feet of Orinda Formation throughout most of the area, as shown on cross section G-G' (Figure C2.3-8). Therefore, the Great Valley Group is thought to be of minor importance to the hydrogeology of the Support Services Area. Hydraulic conductivities of the Orinda Formation and colluvium calculated from slug tests of wells in the Support Services Area are shown on Figure C2.4-1. Few wells screened in the Orinda Formation can produce a sustainable yield to allow conducting interference pumping tests. The hydraulic conductivity data indicate that the Orinda Formation and colluvium have relatively low hydraulic conductivities. Measurements of the yield of three wells screened in the Orinda Formation and colluvium in this area ranged from 24 to 76 gallons per day. No data are available regarding the hydraulic conductivity of the artificial fill underlying many of the developed parts of the area.

Since the Orinda Formation in most places crops out at the surface, or is overlain by only a thin veneer of generally unsaturated surficial materials, groundwater encountered in the Orinda Formation is interpreted to be unconfined. However, due to the variability of lithologies within the formation, it is likely that localized horizons may contain groundwater under confined conditions.

Groundwater flow in the Support Services Area is generally southward following the topographic slope, as indicated by groundwater elevation contours that are generally parallel to the surface topographic contours (Figure C2.4-2). The horizontal component of the hydraulic gradient (dh/dl) ranges from approximately 0.1 to 0.3 within the Support Services Area. Assuming a hydraulic conductivity (K) of $1 \times 10^{-8}$ meters per second, which appears to be typical for the Orinda Formation, and an effective porosity ($n_e$) of approximately 0.25, Darcy's law ($v_x = K/n_e \times dh/dl$) indicates that the average linear groundwater velocity ($v_x$) would be approximately 0.4 meters/year (1.3 feet per year) within rocks of the Orinda Formation. In the creek deposits, where the hydraulic conductivity could be an order of magnitude higher, the ground water velocity could be on the order of 4 meters per/year (13 feet/year). Deeper sections of the Orinda Formation, which have extremely low hydraulic conductivities in the adjacent Old Town Area

(as described in Module B), would probably have substantially lower groundwater velocities. It should be noted that due to the variability in gradients and bedrock physical characteristics, these calculations give only rough, order-of-magnitude estimates of likely groundwater flow velocities in the Support Services Area.

Groundwater elevation hydrographs from clustered shallow and deep wells (Figures C2.4-3 through C2.4-5) were examined to evaluate the vertical component of the groundwater potentiometric gradient. Data were available from the following well pairs, which are relatively close to one another, near Building 75.

| Well Pair | Unit(s) Screened | Water Level (feet) | Vertical Direction |
|---|---|---|---|
| MW91-4 | Orinda Formation | 860 | Down |
| MW75-96-20 | Orinda Formation | 920 | |
| MW91-4 | Orinda Formation | 860 | Down |
| MW75-99-7 | Artificial Fill/Orinda | 960 | |

These data indicate that the vertical component of the hydraulic gradient is downwards near Building 75.

The relative abundances of major cations and anions in groundwater within the Support Services Area are shown as Stiff diagrams on Figure C2.4-6. Most wells within the area are screened in the Orinda Formation, with a few wells screened within the surficial units (colluvium, fill). Therefore, insufficient data are available to evaluate potential correlations between groundwater chemistry and lithology in this area. However, systematic spatial variations in groundwater chemistry can be observed, such that clusters of adjacent wells in several locations show similar chemical signatures in comparison to more distant wells. For example, wells located northwest of Building 75 show substantially lower sodium+potassium cation concentrations than wells located northeast of Building 75. Wells surrounding Building 76 have similar groundwater chemical signatures that contrast with those observed to the east and southeast. In addition, wells that extend along the axis of the present Chicken Creek northward along the former creek bed toward Building 75 have a different chemical signature from other wells in the area.

## *C2.5 Support Services Area Conceptual Hydrogeologic Model*

The hydrogeologic information discussed above suggests the following conceptual model for groundwater flow in the Support Services Area.

Groundwater flow primarily occurs within the Orinda Formation. The flow direction is generally southwards, parallel to the slope of the overlying topography. Groundwater velocities are apparently very low, on the order of 1 foot per year, in the Orinda Formation. However, velocities could be substantially greater where the water table is in the colluvium and alluvium that occupies the former upper Chicken Creek stream canyon. The near coincidence of the water table with the contact in that area (cross section C-C', Figure C2.3-4) supports this hypothesis. The apparent vertical gradient observed in the well cluster near Building 75 suggests that some degree of flow may occur downwards into the Orinda Formation. However, groundwater flow within the Orinda Formation is likely to be of minor importance, as indicated by the relatively low values of hydraulic conductivity measured in the unit.

Some groundwater flow is captured by subdrains (Figure C2.2-4) and hydraugers (Figure C2.2-5). This is particularly true at the base of the slopes immediately north of Building 77 and the Building 69/75 complex. The captured water is routed through the storm drain system to Chicken Creek.

# C3 SOIL CONTAMINATION - CHARACTERIZATION ACTIVITIES AND INTERIM CORRECTIVE MEASURES

The following subsections describe the results of the RFI investigations at SWMUs and AOCs in the Support Services Area where soil characterization activities were conducted subsequent to those included in the Draft Final RFI Phase II Progress Report (LBNL, 1995k) (Table C1-1). As described in Section 1 of this report, the results of these characterization activities were used to help assess whether further action was required at a site (i.e., whether the unit will be included in the site-wide risk assessment). The assessment was made by comparing analytical results to both LBNL background levels and Preliminary Remediation Goals (PRGs) for residential soil (USEPA, 1999). PRGs for residential soil for metals and organic site

contaminants and LBNL background levels for metals are listed in Section 1, Table 1.6-3a and 1.6-3b.

For organic constituents, Chemicals of Potential Concern (COPCs) and soil analytical results are presented in unit-specific tables in each subsection. For metals, soil analytical results are presented for all units in Table C3-1. Metals results are generally discussed in this module only when concentrations exceed both PRGs for residential soil and background levels, since metals concentrations that are within background levels are not considered to represent contamination and metals concentrations that are below PRGs for residential soil are not considered to be of concern.

The potential for contaminants detected in soil to migrate to surface water and sediment has been addressed by collecting surface water and sediment samples from Chicken Creek and analyzing them for chemicals of potential concern from potential upgradient sources within the Support Services Area. A discussion of this sampling is provided in Section C4.5. Potential migration of soil contaminants to groundwater has been addressed by installing and sampling groundwater monitoring wells both within and downgradient from the Support Services Area, as discussed in Section C4.3 and Section C4.4.

## *C3.1 SWMU 3-6: Building 75 Former Hazardous Waste Handling and Storage Facility*

### Description and History

The former Hazardous Waste Handling Facility (HWHF) operated at the Building 75 location (Figures C-3 and C3.1-1) from about 1962 until 1998, after which time hazardous waste handling activities were moved to a new HWHF at Building 85. The facility stored wastes generated at LBNL pending disposal offsite. Wastes handled at the facility included polychlorinated biphenyl (PCB)-containing and non-PCB-containing waste oils, asbestos, acids, tritium, chlorides, nitrites, organic and inorganic solvents, empty hazardous chemical or waste drums, and other wastes. The facility was also used to handle, store, package, and solidify

radioactive waste. The description of the HWHF in the RFA (LBNL, 1992d) included the following:

> There is a hazardous waste storage area outside of Room 131 which has drums containing waste acids on pallets with secondary containment. In the past, the acids were poured into the drums from bottles. There are many lockers around the area used for storing hazardous materials in small "store-it" plastic containers on shelves within the lockers. PCB-containing oils are also stored prior to disposal within a fenced and secured area in the Radioisotope Services yard at Building 75. The storage unit is a metal shed with a diked area consisting of two 8 ft by 9 ft by 6-inch high sections. The storage unit is properly labeled and containers holding PCB oils are inspected daily for leaks.
>
> The Building 69A waste storage area is located at the east corner of Building 69A. Sealed waste drums are stored on racks over a double-coated bermed concrete floor.

Closure activities for the former HWHF, which consisted of surface wipe sampling of building interiors and equipment, decontamination of surfaces for which sample concentrations exceeded closure performance standards, and soil sampling, started on April 21, 1997. Closure investigations. Results of the closure investigations were submitted to DTSC in April 1998 (LBNL, 1998o). LBNL received acceptance of the closure certification for the facility from the DTSC in July 1998; however, the approval was conditional on the contaminated soils at the unit being included in the Corrective Measures Study Phase of the RCRA Corrective Action Process.

The No Further Investigation (NFI) status request for the Building 75 Former Hazardous Waste Handling and Storage Facility that was submitted to DTSC in February 2000 (LBNL, 2000d) is included in Appendix C. Following is a summary of the information contained in the NFI request.

## Soil Sampling

Soil samples were collected both inside the boundaries of the former HWHF and immediately outside its perimeter. Sampling locations are shown on Figure C3.1-2 and described below:

- In November 1991, soil samples were collected to 55 feet bgs during installation of monitoring well MW91-4 east of Building 75A.

- In July 1996, soil samples were collected from four 20- to 30-foot-deep borings near Building 75A in order to investigate the source of benzene contaminated groundwater detected in monitoring well MW91-4. Boring SB75-96-1 was drilled north of well MW91-4, and borings SB75-96-2, SB75-96-3, and SB75-96-4 were drilled along the sanitary sewer line between Buildings 75 and 75A to assess whether the benzene could have originated from sewer line leaks. The four borings were subsequently converted to multi-level vacuum lysimeters to allow collection of soil-water samples.
- In September 1996, angled boring SB75A-96-1 was drilled under the north end of Building 75A. Samples were collected at distances of 3.8 to 22.5 feet along the borehole.
- In February 1997, soil samples were collected to 50 feet bgs during installation of monitoring well MW75-96-20, along the east wall of Building 75A.
- As part of HWHF closure activities in 1997 and 1998, soil samples were collected from 48 soil borings (SB75AHW-97-1 through SB75AHW-97-15, SB75EHW-97-1 through –3, SB75FLHW-97-1 through –4, SB75JHW-97-1 and -2, SB75J-97-3, SB75LYHW-97-1 through –6, SB75YHW-97-1 through -8, SB75Y-97-1 through –5, -9 and –10, SB75YSWR-97-1 and –2) drilled in chemical storage areas, chemical transfer areas, and other areas in the Building 75/75A area where releases could potentially have occurred. The initial round of samples was collected to a depth of approximately 4 feet using a hand-auger. Samples were subsequently collected to depths of up to 8 feet using Geoprobe™ sampling equipment to further characterize the magnitude and extent of contamination. Soil samples were also collected at nine locations both inside the boundaries of the Building 69A waste storage area (SWMU 3-1) and immediately outside its perimeter.
- In April 1998 after closure was completed, two soil borings (SB75A-98-1 and SB75A-98-2) were drilled to a depth of 11 feet bgs at the southeast corner of Building 75A to further characterize the extent of PCB contamination found beneath the building.
- In September 1998, soil samples were collected during installation of monitoring wells MW75-98-14 and MW75-98-15, which were installed to characterize the extent of tritium contamination in groundwater.
- On July 20, 1999, soil samples were collected during installation of monitoring well MW75-99-4, which was installed to assess whether PCBs were present in groundwater downgradient from an area of PCB-contaminated soil.

- As noted above, DTSC's acceptance of the closure certification for the Former Hazardous Waste Handling and Storage Facility was conditional on contaminated soils being included in the RCRA Corrective Action Process. LBNL therefore submitted a workplan to DTSC in August 1999 (LBNL, 1999n) that specified additional soil sampling requirements and provided the rationale for the sampling. In accordance with the workplan, soil samples were collected from 40 borings (SB75A-

99-1 through –37 and SB75A-99-27A, -37A and -37B) primarily located west of Building 75A, approximately encompassing the area of PCB contaminated soil.

PCBs were detected in two main areas of the former HWHF: 1) in the vicinity of the "J pad" west of Building 75A, and 2) at the southeast corner of Building 75A (Table C3.1-1 and Figures C3.1-2 through C3.1-6). As shown on cross sections of these areas (Figures C3.1-7 through C3.1-9), PCB concentrations exceeding the PRG for residential soil (0.2 mg/kg) are limited to the upper 7 feet of soil. Results of other analyses, which are included in Table C3.1-1 and Table C3-1, were as follows:

- TPH-C/WO was detected in generally the same areas as the PCB contamination discussed above, and in a few additional scattered locations (Figure C3.1-10).
- Five samples were analyzed for a full range of petroleum hydrocarbons (Fuel Identification Analysis), of which three contained total petroleum hydrocarbons in the ranges of kerosene, diesel, motor oil, and/or hydraulic/motor oil.
- Solvent-related compounds (i.e. non-aromatic halogenated VOCs and acetone) were detected in only a few scattered samples at concentrations substantially lower than PRGs for residential soil (Figure C3.1-11).
- Fuel-related VOCs were only detected in a few samples east of Building 75A, at concentrations substantially lower than PRGs for residential soil (Figure C3.1-12).
- No pesticide compounds were detected in the Building 75/75A area. Dieldrin (0.041 mg/kg) was detected at a concentration slightly above the PRG for residential soil (0.03 mg/kg) in one sample collected outside the former Building 69A waste storage area during the closure investigations.
- SVOCs detected in soil included several phthalate compounds, phenanthrene, and benzyl alcohol (Figure C3.1-13). These compounds were detected beneath Building 75A, and along the western facility boundary at concentrations substantially lower than PRGs for residential soil.
- The only metals detected at concentrations exceeding both background and PRGs for residential soil were chromium and nickel (Figure C3.1-14).

## Potential Migration of Contaminants

### *Surface Water and Sediment*

Contaminated soil at SWMU 3-6 lies beneath paving, precluding erosion and migration of soil contaminants to surface water. In addition, both surface-water and sediment samples have

been collected from sampling locations in Chicken Creek, which receives runoff from the unit. The results of this sampling are discussed in Section C4.5.1. Trace concentrations of PCBs (0.014 mg/kg) and p-isopropyltoluene (0.0058 mg/kg), which were detected in a single sediment sample each, were the only organic analytes detected in both sediment samples collected from Chicken Creek and soil samples collected at SWMU 3-6. Based on a comparison of the type and concentrations of contaminants detected in the sediment to contaminants detected in soil at SWMU 3-6, it is unlikely that SWMU 3-6 is the source of the sediment contamination (LBNL, 2000d). The potential impact to the environment from contaminants detected in sediment will be evaluated in the ecological risk assessment.

***Groundwater***

To assess whether migration of contaminants in the soil at SWMU 3-6 could potentially impact groundwater, LBNL performed transport and fate modeling of PCBs in the soil and modeling of potential partitioning of PCBs between soil and groundwater. The results of the modeling were reported to DTSC in a letter dated October 8, 1999. The transport and fate modeling predicted that PCBs migrating vertically through the vadose zone would not impact groundwater quality. The partitioning modeling predicted that concentrations of any PCBs dissolved in groundwater, resulting from potential contact with contaminated soil, would not be detectable. To confirm the results of the modeling, monitoring wells were installed in the areas of maximum soil contamination and in downgradient areas. The results of this sampling, which are discussed in Section C4.1 through C4.4, indicate that groundwater has not been impacted by site contaminants.

## Status of Unit

LBNL submitted a request for NFI status for SWMU 3-6 to DTSC in February 2000 (LBNL, 2000d). The request, which is included in Appendix C, provided the following information:

- Soil investigation results to evaluate the potential for past releases and assess the magnitude and extent of contamination. These results showed that the soil at SWMU 3-6 contained contaminants (primarily PCBs) at concentrations exceeding both background levels and PRGs for residential soil.

- Groundwater, surface water, and sediment sampling data pertaining to potential migration of contaminants to these media.

After reviewing LBNL's request, DTSC approved NFI status for SWMU 3-6 in April 2000 (DTSC, 2000b). This unit will be included in the Human Health Risk Assessment because of the detection of contaminants in the soil at concentrations above LBNL background levels and PRGs for residential soil.

## *C3.2 SWMU 4-3: Building 76 Motor Pool Collection Trenches and Sump*

### Description and History

During construction of the Building 76 motor pool in 1964, two approximately 1-foot wide by 1.5 foot deep concrete collection trenches were installed within the lower level of the motor pool area (Figures C-3 and C3.2-1) to capture overflows, incidental spills, and washdown water. The approximately 50-foot long trench along the northern edge of the motor pool carport is used currently. The approximately 15-foot long trench located immediately west of the fuel pump-island was abandoned and backfilled with concrete sometime between 1992 and 1997. Prior to 1988, the contents of both trenches drained directly into the sanitary sewer. Subsequently, the garage area sump, constructed of fiberglass-lined concrete, was installed to collect the contents of the trenches. The liquids are pumped from the garage area sump through the oil/water separator (SWMU 4-2) located on the second level of the motor pool. After separation of the oil, the water is discharged to the sanitary sewer.

### Soil Sampling

Soil samples were collected near the motor pool collection trenches and garage area sump during several rounds of sampling. Sampling locations are shown on Figure C3.2-1 and described below:

- During the RFA, soil samples were collected at 10 feet bgs from two soil borings (SS76S-12 and SS76S-13) near the backfilled collection trench. These borings were installed at the location where relatively high concentrations of fuel related compounds were detected in soil gas (LBNL, 1992d).

- In June 1994, to help assess whether a release had occurred from the collection trenches or sump, soil samples were collected from three 21-foot deep soil borings. One boring was installed adjacent to each collection trench (SS76-94-01 and SS76-94-03) and one adjacent to the garage area sump (SS76-94-02).
- In June 1995, samples were collected from five borings (SB76-95-1 through SB76-95-5) drilled to a maximum depth of 25 ft bgs in the area of the backfilled collection trench to further investigate the magnitude and extent of contamination.
- In October 1996, soil borings SB76-96-1 and SB76-96-1A were drilled to depths of 2.5 and 5.5 feet, respectively, adjacent to the backfilled collection trench to help assess the vertical extent of contamination. The borings met refusal and could not be completed. In February 1997, angled boring SB76-97-1 was drilled from the base of the retaining wall south of the motor pool area to a maximum depth of approximately 20 feet below the southern end of the backfilled collection trench to help assess the vertical extent of contamination.

Analytical results for soil samples, which are included in Table C3.2-1 and Table C3-1, were as follows:

- Oil and grease was the primary contaminant detected. It was detected at a maximum concentration of 17,000 mg/kg at 6 feet bgs in soil boring SS76-94-01, adjacent to the backfilled collection trench. No oil & grease was detected in the samples collected from the boring adjacent to the operational collection trench.
- Several fuel-related compounds were detected, including non-chlorinated monoaromatic VOCs (e.g. benzene, 1,2,4-trimethylbenzene, etc.) and several polynuclear aromatic hydrocarbons (PAHs) (e.g. anthracene, phenanthrene, etc.). Benzene was the only fuel-related hydrocarbon detected at a concentration above the PRG for residential soil. Benzene was detected above the PRG in one of the two sample collected during the RFA; however the concentration of benzene was below the PRG in the single sample (out of 19) in which it was detected during the RFI. Total petroleum hydrocarbons in both the diesel (TPH-D) and gasoline (TPH-G) ranges were also detected. The source of the TPH and fuel-related hydrocarbons detected is more likely associated with releases from the Former Gasoline and Diesel USTs (AOCs 4-1 and 4-2), which are discussed in Section C3.4, than with releases from the backfilled collection trench.
- Several solvent related halogenated VOCs (tetrachloroethene [PCE], 1,1,1-trichloroethane (1,1,1-TCA), Freon-12, and Freon-113) were detected, all at concentrations substantially lower than PRGs for residential soil.
- Chromium and nickel were the only metals detected at concentrations above background levels and PRGs for residential soil. Chromium and nickel have been detected at concentrations above both PRGs for residential soil and LBNL background levels at a number of locations in the Building 76 area and are probably naturally occurring at these levels.

## Potential Migration of Contaminants

### *Surface Water and Sediment*

Contaminated soil at SWMU 4-3 lies beneath paving, minimizing the potential for erosion and migration of soil contaminants to surface water. In addition, both surface-water and sediment samples have been collected from sampling locations in Chicken Creek, which receives runoff from the unit. The results of this sampling are discussed in Section C4.5.1.

### *Groundwater*

Wells are located downgradient from Building 76 SWMUs and AOCs (including SWMU 4-3) to monitor groundwater quality. The results of this sampling are discussed in Section C4.1 through C4.4 and indicate that groundwater south of Building 76 has been impacted by petroleum hydrocarbons (primarily diesel and gasoline) and solvents. The adjacent former diesel and gasoline USTs (AOCs 4-1 and 4-2) are a known source of diesel and gasoline contamination.

## Status of Unit

LBNL submitted a request for NFI status for SWMU 4-3 to DTSC in July 1998 (LBNL, 1998j). The request provided soil investigation results pertaining to the potential for past releases and the magnitude and extent of contamination. These results showed that soil at SWMU 4-3 contains nickel and chromium at concentrations above both background levels and PRGs for residential soil. In addition, benzene was detected at a concentration above the PRG in one sample collected during the RFA.

After reviewing LBNL's request, DTSC approved NFI status for SWMU 4-3 in September 1998 (DTSC, 1998). The unit will be included in the Human Health Risk Assessment because of the presence of metals at concentrations above LBNL background levels and PRGs for residential soil and the detection of benzene above the PRG in one sample collected during the RFA.

## *C3.3 SWMU 5-4: Building 77 Plating Shop Floor and Sump*

### Description and History

The plating shop, which is located on the east end of Building 77 (Figures C-3 and C3.3-1), was constructed in 1964. A 15-gallon sump was installed in 1965. Rinse water derived from washing of the plating tank and spilled liquids were directed to the sump via a drain in the plating room basement floor. The sump was cemented over and replaced with a new sump in 1986. At that time, the entire floor was epoxy-coated, and new plumbing was installed, including overflow piping connecting the sinks directly to additional new double-contained sumps. Two 45-gallon lift-station tanks were installed beneath the shop subfloor in order to transfer waste from the floor sump to the "future" (now operational) Building 77 wastewater pre-treatment unit (SWMU 5-3).

Prior to construction of the "present" (no longer operational) Building 77 wastewater pre-treatment unit (SWMU 5-2) in 1984, the sump contents were discharged directly to the sanitary sewer. Subsequently, the sump contents have been periodically tested, and discharged to the sanitary sewer when concentrations met East Bay Municipal Utility District (EBMUD) discharge limits, or to the pre-treatment unit when concentrations exceeded those limits.

### Soil Sampling

In 1988, soil samples were collected at four locations beneath the concrete subfloor of the plating shop (DTSC, 1991). PCE (maximum concentration 0.094 mg/kg) and trace concentrations (maximum <0.001 mg/kg) of 1,1,1-TCA and cyanide were detected, indicating a release to soil from the unit (LBNL, 1992d). Soil samples were subsequently collected during the RFI to assess the magnitude and extent of contamination. The soil sampling locations are shown on Figure C3.3-1 and discussed below:

- In June 1994, soil samples were collected from five soil borings (BS77Plate-94-01 through BS77Plate-94-05) drilled through the plating shop floor to approximately 8 to 11 feet bgs. Boring locations were selected to obtain representative samples from throughout the shop area. In addition, boring BS77Plate-94-02 was located near the sump where contamination had been detected in earlier sampling. Samples were

collected while the soil beneath the plating shop was accessible, before the new plating shop floor was sealed.

- In December 1998, a hole approximately 5 feet square by 2 feet deep was excavated in the subfloor to allow installation of a new sump. Soil samples were collected at a depth of approximately 2 feet below the excavation at two locations (SS-77PLExc-98-1 and SS-77PLExc-98-2).
- In April 2000, six shallow soil samples were collected from beneath the floor immediately north of the plating shop, to assess potential hazards to construction workers rehabilitating the building.

Analytical results for soil samples, which are included in Table C3.3-1 and Table C3-1, were as follows:

- Solvent-related halogenated non-aromatic VOCs (primarily PCE) were detected in most of the samples collected beneath the plating shop floor (Figure C3.3-1). Trichloroethene (TCE), 1,1,1-TCA, 1,1-dichloroethane (DCA), and methylene chloride were also detected. In addition, styrene, an aromatic non-halogenated VOC was detected in one sample collected beneath the sump. All concentrations were below PRGs for residential soil.
- Two samples collected immediately beneath the sump location were analyzed for SVOCs. Dimethyl phthalate was detected at a concentration lower than the PRG for residential soil in one of the samples.
- Hexavalent chromium (CrVI) was the only metal detected at a concentration above both background levels and PRGs for residential soil. The concentration was above the PRG in one of the two samples in which it was detected immediately beneath the sump location.
- Measured pH values ranged between approximately 8 and 9, which is consistent with typical soil pH values measured at LBNL. These results do not show evidence that soils beneath the plating shop have been impacted by releases of acidic or alkaline plating solutions.

## Potential Migration of Contaminants

### *Surface Water and Sediment*

Contaminated soil at SWMU 5-4 lies beneath the building, precluding potential erosion and migration of soil contaminants to surface water. In addition, both surface-water and sediment samples have been collected from sampling locations in Chicken Creek, which receives runoff from the area surrounding the unit. The results of this sampling are discussed in Section

C4.5.1, and show no evidence of surface water or sediment impacts from contaminants found at this unit.

***Groundwater***

Two wells located east and south of the plating shop monitor groundwater quality in this area. VOCs have not been detected in either of these wells since July 1996. The results of this sampling are discussed in Section C4.1 through C4.4.

## Status of Unit

LBNL submitted a request for NFA status for SWMU 5-4 to DTSC in January 1996 (LBNL, 1996a). The request provided soil investigation results pertaining to the potential for past releases and the magnitude and extent of contamination. The results showed that concentrations of contaminants were below PRGs for residential soil. After reviewing LBNL's request, DTSC approved NFA status for SWMU 5-4 in July 1996 (DTSC, 1996b).

In December 1998 after NFA approval, additional samples were collected beneath the subfloor at the location excavated for the installation of a new sump. As described above, CrVI was detected at a concentration above the PRG for residential soil in one sample. Therefore, SWMU 5-4 will be included in the Human Health Risk Assessment.

# *C3.4 AOC 4-1: Building 76 Former Gasoline UST and AOC 4-2: Building 76 Former Diesel UST*

## Description and History

A 10,000-gallon unleaded gasoline underground fuel storage tank (UST) AOC 4-1) and a 10,000-gallon diesel UST (AOC 4-2) were formerly located on the southwest side of Building 76 (Figure C-3 and C3.4-1). The gasoline UST, installed in 1979, was a single-walled fiberglass tank; the diesel UFST, installed in 1964, was a single-walled steel tank. In April 1988, the Former Diesel UST failed a tank integrity test, apparently the result of an uncapped vapor return line. An Unauthorized Release/Contamination Site Report was issued to the City of Berkeley

Department of Health and Human Services (COB/DHHS). Both tanks were removed and replaced with double-walled tanks (designated as AOC 4-3 and AOC 4-4) in November 1990 (Geo/Resource Consultants, 1991). Presently, the site is an active motor pool facility with a refueling pump island.

## Soil Sampling

Soil samples were collected both during tank removal operations, and during subsequent investigations of soil contamination associated with the former USTs. Sample locations are shown on Figure C3.4-1, and discussed below:

- In November 1990, during UST removal operations, samples were collected to document the residual contamination. Four soil samples (T2-W1, T2-E1, T3-W1, T3-E1) were collected from the base of the tank excavation, two samples (T3-S2, T3-SW2) were collected near the removed fuel island, and one sample (SW1) was collected adjacent to the fuel piping.
- In February 1997, two angled borings were drilled to collect additional soil samples in the area where the highest fuel contamination had been detected. The primary purpose of these borings was to collect chemical specific soil data to support the assessment of potential risk to human health. Boring SB76-97-1 was drilled beneath the retaining wall south of the motor pool and boring SB76-97-2 was drilled beneath the former pump island (Figure C3.4-1). The borings were drilled to depths of approximately 20 feet beneath the motor pool surface.
- In February 1997, three 35-foot-deep borings (SB76-97-3, SB76-97-4, and SB76-97-5) were also drilled inside conductor casings that had been installed in the tank excavation when the tanks were replaced. Soil samples were collected from native soil below the base of the former tank excavation. The purpose of these borings was for the installation of temporary groundwater sampling points to help assess the source of the VOC contamination detected in groundwater south of the site.
- In addition to the soil samples described above, other soil borings were drilled between 1994 and 1996 to investigate the adjacent unit (SWMU 4-3 – Building 76 Motor Pool Collection Trenches and Sump), which is discussed in Section C3.2. These borings also provided data relevant to releases from the former USTs.

Analytical results are included in Table C3.4-1 and Table C3-1. Soil contaminated with petroleum hydrocarbons quantified as either TPH-D or TPH-G was detected. The contamination is the result of releases from the former USTs and associated piping. As shown on Figures C3.4-1 through C3.4-3, the principal area of fuel-contaminated soil is located near the former pump-

island. The highest remaining TPH concentrations in this area are present both immediately adjacent to the former excavation walls/floor and near the capillary fringe (at the water table) underlying this area (Figure C3.4-3).

Results of other analyses were as follows:

- Fuel-related aromatic compounds (including both monoaromatic VOCs and PAHs) were also detected at the unit, primarily benzene, toluene, xylenes and phenanthrene. The highest concentrations of these compounds were generally found in samples with high TPH concentrations. The only compound detected at a concentration above the PRG for residential soil was benzene in a sample collected during the RFA at 10 feet bgs in boring SS76S-13-10'. This sample was collected adjacent to the backfilled motor pool collection trench (SWMU 4-3), discussed in Section 3.2 (Figure C3.4-1).
- Samples from several borings to the west of the UST excavation contained oil & grease and solvent-related halogenated VOCs (1,1,1-TCA, PCE, Freon 12, Freon 113, and chloroform). None of these constituents was detected at concentrations exceeding PRGs for residential soil. This contamination is unlikely to have been derived from the USTs. VOCs have been detected in groundwater in this area. Results of groundwater sampling are discussed in Section C4.

Chromium and nickel were the only metals detected at concentrations exceeding both PRGs for residential soil and background levels (Table C3-1). These samples were collected from borings located close to the motor pool collection trenches (Section C3.2). Chromium and nickel have been detected at concentrations above PRGs for residential soil and background levels at a number of locations in the Building 76 area and are probably naturally occurring at these levels.

## Potential Migration of Contaminants

### *Surface Water and Sediment*

The release at AOCs 4-1 and 4-2 was subsurface and contaminated soil lies beneath paving, precluding potential erosion and migration of soil contaminants to surface water. In addition, both surface-water and sediment samples were collected from sampling locations in Chicken Creek, which receives runoff from the unit. The results of this sampling are discussed in Section C4.5.1.

***Groundwater***

Wells are located downgradient from Building 76 SWMUs and AOCs (including SWMU 4-3) to monitor groundwater quality. The results of this sampling are discussed in Section C4.1 through C4.4 and indicate that groundwater south of Building 76 has been impacted by releases of petroleum hydrocarbons (primarily diesel and gasoline) from the former USTs. Aromatic hydrocarbons have generally not been detected in the groundwater.

## Status of Unit

LBNL submitted a request for NFA status for AOCs 4-1 and 4-2 to the City of Berkeley in July 1997 (LBNL, 1997l). The request provided the following information:

- soil investigation results that provided information on the potential for past releases and on the magnitude and extent of contamination
- groundwater sampling data pertaining to potential migration of soil contaminants to these media.

After review of LBNL's request, AOCs 4-1 and 4-2 were approved for NFA status by the City of Berkeley in July 1997 (COB, 1997b).

# *C3.5 AOC 5-4: Building 77 Sanitary Sewer*

## Description and History

For a period of approximately 20 years prior to 1984, wastes from the Building 77 plating shop (AOC 5-4) were discharged directly into the sanitary sewer. During a 1977 sewer-line survey, a segment of the sewer system that received effluent from Building 77 (Figures C-3 and C3.5-1) was found to be chemically corroded. The corroded sewer segment was subsequently replaced, and in 1985, a wastewater pre-treatment unit (SWMU 5-2) was installed on the south side of Building 77 so that waste rinsewater from the plating shop could be treated prior to sewer discharge.

## Soil Gas and Soil Sampling

Soil gas samples were collected along the building 77 Sanitary Sewer line during the RFA in 1991 to help assess whether contaminants had been released from the line. VOCs were detected in the soil gas samples. Soil samples were subsequently collected to assess whether releases from the sewer line were the source of the VOCs detected in the soil gas. In addition, soil samples were collected from the borings for monitoring wells installed near the sewer line to monitor groundwater quality, characterize the magnitude and extent of detected groundwater contamination, and help identify the source of the contamination. Sample locations are shown on Figure C3.5-1, and described below:

- In 1991 and 1992, soil samples were collected at three locations (SS77S-19, SS77E-04C, and SS77E-3) next to the sewer line on the east side of Building 77, in the area where the highest concentrations of halogenated VOCs were detected in the soil gas samples (LBNL, 1992d). Soil samples were also collected from two borings (SB79-1 and SB79-2) adjacent to the sewer line segment that had been found to be corroded in 1977, and from three groundwater monitoring well borings located along the sewer lines (MW77-92-10, MW91-1, and MW91-2).
- In April 1994, two soil borings (SB77-94-1 and SB77-94-2) were drilled east of Building 77 next to the sanitary sewer line as part of an investigation of the steam cleaning area of the Building 77 Former Yard Decontamination and Solution Bath Area (SWMU 5-10).
- In May 1994, soil samples were collected from monitoring well borings MW77-94-5 and MW77-94-6 south of Building 77.
- In 1997, soil samples were collected from monitoring well boring MW77-97-10 south of Building 77.

Analytical results for soil samples, which are included in Table C3.5-1 and Table C3-1, were as follows:

- The only VOCs detected were trace concentrations (<0.1 mg/kg) of PCE, TCE, cis-1,2-dichloroethene (cis-1,2-DCE) and 1,1-DCA on the east side of Building 77, in the area of the steam cleaning pad (part of SWMU 5-10) (Figure C3.5-1), which is a likely source for the contamination. Concentrations of VOCs detected were substantially lower than PRGs for residential soil. No VOCs were detected in samples collected along the sanitary sewer line along the south side of the building.

- Petroleum hydrocarbons consisting of TPH quantified as crude oil (TPH-CO), total hydrocarbons (THC), and oil & grease were also detected east of Building 77 in the area of the steam-cleaning pad.
- Cyanide was detected in one sample from well boring MW91-1 at a concentration below the PRG for residential soil.
- No metal was detected at a concentration above both background levels and PRGs for residential soil.

## Potential Migration of Contaminants

### *Surface Water and Sediment*

Any release from AOC 5-4 would be subsurface and contaminated soil lies beneath paving, precluding potential erosion and migration of soil contaminants to surface water. In addition, both surface-water and sediment samples were collected from sampling locations in Chicken Creek, which receives runoff from the unit. The results of this sampling are discussed in Section C4.5.1, and indicate no evidence of impacts to either surface water or sediments from the VOCs detected in soil samples collected near AOC 5-4.

### *Groundwater*

To evaluate whether migration of contaminants from soil at AOC 5-4 or from other units in the vicinity had impacted groundwater, monitoring wells were installed along the sanitary sewer line south and east of Building 77. The results of this sampling, which are discussed in Section C4.1 through C4.4, show that VOCs have only been sporadically detected in groundwater, except for wells MW91-2 and MW77-92-10. Groundwater samples from MW91-2, located near the southwest corner of building 77, have consistently contained several halogenated VOCs found in shallow soil samples beneath and to the east of the building. VOCs have not been detected in well MW77-92-10, located east of the building, since July 1996. The groundwater monitoring results suggest that the extent of groundwater contamination is limited, and that there may be multiple sources of the contamination.

## Status of Unit

LBNL submitted a request for NFA status for AOC 5-4 to DTSC in July 1998 (LBNL, 1998j). The request provided soil investigation results pertaining to the potential for past releases and the magnitude and extent of contamination. These results showed no evidence that a release had occurred from the sewer line. In addition, concentrations of contaminants detected were below PRGs for residential soil.

After review of LBNL's request, AOC 5-4 was approved for NFA status by DTSC in September 1998 (DTSC, 1998).

## *C3.6 Chicken Creek Former Poultry Research Station*

## Description and History

The poultry research station was formerly located near the head of Chicken Creek (Figures C-3 and C3.6-1). A parking area was planned for construction at the location of a former chicken coop, so soil samples were collected in 1997 to screen the area for soil contamination.

## Soil Sampling

In 1997, nine soil samples (SS-CKPit-1A through SS-CKPit-9A) were collected at depths ranging from 2 to 5 feet bgs from a test pit excavated on the southeast side of the former chicken coop. The samples were analyzed for pesticides, SVOCs, and metals. Three of the shallow samples (i.e., <3 feet bgs) were found to contain both 4,4'-DDE and 4,4'-DDT, but at concentrations substantially lower than PRGs for residential soil (Table C3.6-1). No other organic analytes were detected, and no metals were detected at concentrations exceeding both background levels and PRGs for residential soil (Table C3-1).

## Potential Migration of Contaminants

### *Surface Water and Sediment*

Runoff from the area surrounding the former poultry station flows into Chicken Creek. The potential impact to sediment from the 4,4-DDE and 4,4-DDT detected in soil at the station was evaluated by collecting sediment samples from the creek and analyzing them for organochlorine pesticides. No organochlorine pesticides were detected.

## Status of Unit

This area has not been designated as a SWMU or AOC, and no contaminants have been detected in the area at concentrations greater than PRGs for residential soil.

# *C3.7 Grizzly Electrical Substation*

## Description and History

Grizzly Electrical Substation (Figures C-3, C3.7-1, and C3.7-2) is an electrical distribution substation formerly owned by Pacific Gas and Electric (PG&E) and located on property owned by the University of California (UC). In 1998, UC purchased the substation from PG&E, which had operated the Substation since 1965 and then transferred the substation and property to LBNL. Prior to 1965, the property was used as a parking area.

The substation receives power at 115 kilovolts (kV) via dual PG&E transmission lines. Two transformer banks are then used to step the voltage down to 12.47 kV for distribution to LBNL and UC facilities. Equipment on the site includes eight oil-insulated transformers, several oil-filled circuit breakers (OCBs), a control building, a battery rack, and a vacuum circuit breaker (VCB). The concrete transformer and circuit-breaker pads are surrounded by gravel pits approximately 1 to 1.5 feet deep.

A sampling report prepared by PG&E (PG&E, 1994) indicated that transformer leaks observed during a site walkdown had been repaired and a small volume of contaminated soil

derived from the leaks had been removed. In addition, a UC employee had noted that a small oil spill had occurred in approximately 1978 or 1979 when an idle regulator had been contacted by an energized cable during construction work. Oil-stained soil was reportedly removed from the site and the regulator was replaced with the VCB.

## Sampling

In August 1994, PG&E collected soil samples from the gravel catchment areas adjacent to the two transformer banks and the VCB, and from two locations adjacent to the boundary of the substation (PG&E, 1994).

In June 1998, LBNL collected soil samples (GS-98-1 through GS-98-24) both from the areas previously sampled by PG&E, and from the previously unsampled gravel catchments within the substation area. Samples were collected to a maximum depth of approximately 1.5 feet beneath the asphalt or gravel.

Sampling locations and concentrations of analytes detected are shown on Figure C3.7-1 (PG&E samples) and Figure C3.7-2 (LBNL samples). Analytical results are listed in Table C3.7-1. Samples collected by both PG&E and LBNL showed that PCBs were present in soil adjacent to the switching station. In addition, one sample collected by PG&E in the northeast part of the facility (GS4 on Figure C3.7-1) also contained PCBs, but a nearby sample collected by LBNL (GS-98-24-1) contained no detectable PCBs. Concentrations of PCBs reported by PG&E (1.2 mg/kg maximum) were above the PRG for residential soil (0.2 mg/kg). However, PCBs were either not detected, or were detected at concentrations lower than PRGs in subsequent LBNL samples collected at the same locations. Concentrations of PCBs detected were well below the Toxic Substances Control Act (TSCA) self implementing cleanup level for soil in low occupancy (e.g. electrical substation) areas ranges from 25 mg/kg to 100 mg/kg.

TPH-D (1,800 mg/kg maximum concentration) was detected in several of the samples collected by PG&E. Petroleum hydrocarbons in the ranges of diesel, crude/waste oil, and hydraulic/motor oil were detected in samples collected by LBNL. Samples were also collected by LBNL at four locations where the maximum concentrations of TPH-D had been detected in

the PG&E samples and analyzed for individual fuel components (i.e. aromatic hydrocarbons and PAHs). No PAHs or aromatic hydrocarbons were detected.

## Potential Migration of Contaminants

### *Surface Water and Sediment*

Contaminated soil at the Grizzly Substation lies beneath paving or inside the gravel catchments, precluding potential erosion and migration of soil contaminants to surface water. In addition, surface-water and sediment samples were collected from sampling locations in Chicken Creek, which receives runoff from the area. The results of this sampling are discussed in Section C4.5-1. PCBs were detected at a concentrations lower than the PRG for residential soil in one sediment sample collected from Chicken Creek. The source of the PCBs is not known. The potential impact to the environment from contaminants detected in sediment will be evaluated in the ecological risk assessment.

## Status of Unit

This area is an active electrical substation and has not been designated a SWMU or AOC. No further investigations or remedial measures are recommended for the Grizzly Substation site. Concentrations of PCBs detected in soil at the site are well below the TSCA cleanup level.

## *C3.8 Other Soil Sampling*

Soil samples were also collected at other locations in the Support Services Area that are not associated with specific SWMUs or AOCs or with other investigations of potential contamination discussed previously. These locations, which are shown on Figure C3.8-1, include:

- a temporary groundwater sampling point (SB69A-99-1) installed to help identify the source of groundwater contamination west of Building 69A.
- shallow soil samples collected beneath Building 77 (samples SS-77-99-1, -3, -4, and -5 and SS-77-00-2 through SS-77-00-11) to address potential health and safety concerns during building renovation.

- three borings (SB31-97-1 to SB31-97-3) installed on the east side of Chicken Creek to assess the geology.

Analytical results are included in Table C3.8-1. The only contaminants detected were PCE and p-isopropyltoluene in samples collected beneath Building 77 and cis-1,2-DCE in samples collected beneath the water table in SB69A-99-1. SB69-99-1 was installed to help identify the source of the cis-1,2-DCE detected in groundwater in this area.

# C4 NATURE AND EXTENT OF CONTAMINATION IN GROUNDWATER AND SURFACE WATER

## *C4.1 Introduction*

The primary contaminants detected in groundwater in the Support Services Area have been solvent related halogenated non-aromatic VOCs and fuel hydrocarbons. The most widespread of these are the VOCs, which are present in several relatively small, apparently isolated areas (Figure C4.1-1). The solvent contaminated groundwater immediately south of Building 76 has been designated as a groundwater plume AOC (AOC 4-5 - Building 76 Solvent Contaminated Groundwater) since the groundwater contamination in this area has been detected in several temporary groundwater sampling points and monitoring wells. The other areas of groundwater contamination have not been designated as groundwater plume AOCs.

Tritium is also present in groundwater in the Support Services Area. As was described previously, however, discussions of radionuclide contamination are not included in this RCRA report. Except for one location, concentrations of tritium detected in groundwater monitoring wells have been below the Maximum Contaminant Level (MCL) for drinking water. The tritium plume extends over most of the area where VOCs have been detected in the groundwater in the Support Services Area.

The magnitude and extent of groundwater contamination in the Support Services Area are documented in the attached analytical tables and illustrated on isoconcentration contour maps and cross sections referenced in the following sections. The contamination was characterized based primarily on groundwater samples collected from monitoring wells and temporary

groundwater sampling points, and water samples collected from flowing hydraugers north and west of Building 77.

For comparison purposes, MCLs are referenced on the groundwater sampling result tables. MCL values given represent the more restrictive of either the Federal (Safe Drinking Water Act [40 CFR 141]) or State (CAL-EPA CCR Title 22) standards.

The isoconcentration contour maps (plume maps) display the arithmetic mean of contaminant concentrations detected during Fiscal Year 1999 (FY99) (October 1, 1998 to September 30, 1999). To present a consistent and representative depiction of conditions at the water table, the plume maps were drawn using data from wells screened in the upper portion of the saturated zone (generally within approximately 10 feet of the water table). For wells in which specific chemicals were detected during some, but not all, sampling events, mean concentrations were calculated by using one-half of the laboratory reporting limit as the non-detect concentrations. For wells that were not sampled during FY99, the results from the most recent (pre FY99) sampling event were utilized for contouring unless the results appeared to represent an outlier, in which case results from a prior sampling event were substituted.

The vertical distribution of contaminants in groundwater is depicted on the attached hydrogeologic cross sections, which include data collected from wells screened in the deeper portion of the saturated zone. The cross sections show geology, groundwater levels, total halogenated VOC concentrations, and isoconcentration contour lines. These data were based on the isoconcentration contour maps, geological and hydrogeological information collected from monitoring wells and temporary groundwater sampling points, and the conceptual model described in the following section. Significantly lower concentrations of contaminants have been detected in the deeper wells, which is consistent with the conceptual model.

## *C4.2 Conceptual Model for Contaminant Transport in Groundwater*

According to the conceptual hydrogeologic model discussed in Section C2.5, the water table in the Support Services Area lies primarily within the relatively low permeability Orinda Formation rocks. To a much lesser extent, the water table may also be found in overlying

colluvium and fill, depending on the location and season. Groundwater flows generally southward parallel to the surface slope, toward Chicken Creek (Figure C2.4-2).

The following conceptual model was developed for contaminant transport, based primarily on the type, concentration, and distribution of contaminants detected in the groundwater.

- Plumes of groundwater contamination in the upper portion of the saturated zone are generally elongated along the direction of groundwater flow. This is consistent with advection being the predominant contaminant transport mechanism, as would be expected given the relatively steep groundwater gradients of the upper portion of the saturated zone. Groundwater contamination is present in several isolated areas apparently originating from different sources within the Support Services Area. These areas of groundwater contamination do not appear to coalesce.

- The Orinda Formation impedes the horizontal and vertical migration of contaminants in the groundwater. This model is supported by analytical results from five deep wells (MW71B-00-2, MW58-00-3, MW7-00-4, MW25A-00-5, and MW52A-00-6) that were screened entirely in the Orinda Formation in response to concerns of the regional Water Quality Control Board (RWQCB) on the vertical extent of groundwater contamination. As reported in Modules A and B, contaminants have generally not been detected in these wells. The model is also supported by analytical results from wells in the Support Services Area, west and southwest of Building 69A. The maximum concentrations of groundwater contaminants in this area have been detected in SB69A-99-1, which is screened in fill, and MW69-97-8, which is screened in both colluvium and the Orinda Formation. Contamination has generally not been detected in adjacent wells MW69A-92-22 or MW75-97-7, which are screened in the Orinda Formation. In addition, as noted in Section C2.4, a downward hydraulic gradient exists at well MW91-4; however, although VOCs are present in adjacent shallow wells screened near the water table, only trace concentrations (<1 μg/L) of halogenated VOCs have been detected in MW91-4 since 1993. MW91-4 is screened within the Orinda Formation approximately 100 feet below the water table.

- Organic contaminants are often transformed into other compounds by microbial or chemical processes in the subsurface. Halogenated non-aromatic VOCs usually degrade by sequences of reactions that occur under different environmental conditions. As a result of these reactions, intermediate daughter products are often produced. Depending on site conditions, these intermediate products may further degrade into different end-products. Common degradation pathways for halogenated non-aromatic VOCs are shown on Figure C.4.2-1.

## *C4.3 Halogenated Non-Aromatic VOCs in Groundwater*

The halogenated non-aromatic VOCs present in groundwater in the Support Services Area are primarily industrial solvents, (PCE); solvent degradation products (TCE, DCE, 1,1-DCA, vinyl chloride, chloroform, etc); or both. The source of chloroform could also be drinking water, where its presence is the result of the disinfection processes. Concentrations of halogenated non-aromatic VOCs detected in groundwater are presented in Table C4.3-1 (monitoring wells), Table C4.3-2 (temporary groundwater sampling points), Table C4.3-3 (hydraugers), and Table C4.3-4 (slope stability wells). Isoconcentration maps of total halogenated non-aromatic VOCs, PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE, 1,1,1-TCA, 1,1-DCA, vinyl chloride, and chloroform in the Support Services Area are presented on Figures C4.3-1 through C4.3-10, respectively. These figures show mean concentrations detected in FY99, or detected in FY00 for newer wells sampled in FY00 but not in FY99. FY99 and FY00 data were selected for presentation on the isoconcentration maps to depict current conditions at the site. These mean concentrations are also included on cross sections B-B' and F-F' (Figures C4.3-12 and C4.3-13). An index map for the cross sections is shown on Figure C4.3-11.

Based on the type and distribution of halogenated non-aromatic VOCs within the Support Services Area depicted on the isoconcentration maps, five localized areas of groundwater contamination can be distinguished: Building 76 area; Buildings 75/75A area; Building 69A area; Building 75B area; and Building 77 area (Figure C4.1-1). The contaminants present in each area, as indicated on the isoconcentration maps Figures C4.3-1 through C4.3-10, are listed in the following table in order of relative concentrations.

**Halogenated Non-Aromatic VOCs Detected in Groundwater in the Support Services Area at a Mean Concentration Greater Than 1 µg/L During FY99**

| Building 76 Area (AOC 4-5) | Buildings 75/75A Area | Building 69A Area | Building 75B Area | Building 77 Area |
|---|---|---|---|---|
| TCE | TCE | cis-1,2-DCE | 1,1-DCA | cis-1,2-DCE |
| cis-1,2-DCE | cis-1,2-DCE | 1,1,1-TCA | 1,1-DCE | trans-1,2-DCE |
| PCE | 1,1-DCE | Vinyl chloride | | 1,1-DCA |
| | Chloroform* | | | 1,1-DCE |

* The chloroform may be present as the result of water injected into the well for well development.

As indicated on the isoconcentration maps (Figures C4.3-1 through C4.3-10 – mean concentration in FY99) and in the following table (maximum concentration detected from April 1 to September 30, 2000), halogenated hydrocarbons have either not been detected or detected at relatively low concentrations (below MCLs) in groundwater samples collected in the Building 69/75 area. The exception is MW69-97-8, where cis1,2-DCE has been consistently detected at a concentration above the MCL.

**Maximum Concentrations of Halogenated Hydrocarbons Detected in the Building 69/75 Area from April 1, 2000 to September 30, 2000 (Concentrations in μg/L)**

| Chemicals | PCE | TCE | cis-1,2-DCE | 1,1-DCA | 1,1-DCE |
|---|---|---|---|---|---|
| **MCL** | 5 | 5 | 6 | 5 | 6 |
| **Well Number** | | | | | |
| MW91-3 | ND | ND | ND | ND | ND |
| MW91-5 | ND | ND | ND | ND | ND |
| MW91-6 | ND | ND | ND | ND | ND |
| MW69A-92-22 | ND | ND | ND | ND | ND |
| MW75-92-23 | ND | ND | 2.6 | ND | ND |
| MW75B-92-24 | ND | ND | ND | ND | ND |
| MW75-96-20 | ND | 4.4 | 2.9 | ND | ND |
| MW75-97-5 | ND | ND | ND | 2.7 | 4 |
| MW75-97-6 | ND | ND | ND | ND | ND |
| MW75-97-7 | ND | ND | ND | ND | ND |
| MW69-97-8 | ND | ND | **21** | ND | ND |
| MW69-97-21 | ND | ND | ND | ND | ND |
| MW75-98-14 | ND | ND | ND | ND | 2 |
| MW75-98-15 | ND | ND | ND | ND | ND |
| MW75-99-4 | ND | ND | ND | ND | ND |
| MW75-99-6 | ND | ND | ND | ND | ND |
| MW75-99-7 | ND | ND | 5.6 | ND | ND |
| MW75-99-8 | ND | ND | ND | ND | ND |

### *C4.3.1 Building 76 Area (AOC 4-5)*

## Description of Contaminants

The area of solvent-contaminated groundwater in the area of Building 76 has been designated as a groundwater plume AOC (AOC 4-5 - Building 76 Solvent Contaminated Groundwater). TCE is the primary contaminant detected. Groundwater samples collected in this

area during FY99 also contained cis-1,2-DCE, PCE, and chloroform. 1,1,1-TCA; 1,1-DCE; 1,1-DCA; and Freon-113 have been detected in prior years. In addition, diesel- and gasoline- range hydrocarbons have been detected in the same wells as the halogenated non-aromatic VOCs (Section 4.4). The maximum concentrations of VOCs that were detected at concentrations above MCLs in FY99 are shown in the following table:

**Maximum Concentrations of Halogenated Non-Aromatic VOCs Detected at Concentrations Above MCLs in FY99 in the Building 76 Area**

| Chemical | Well | Maximum Concentration Detected (μg/L) | Maximum Contaminant Level (MCL) (μg/L) |
|---|---|---|---|
| TCE | SB76-97-3 | 26.1 | 5 |
| cis-1,2-DCE | MW76-1 | 8.5 | 6 |

The presence of cis-1,2-DCE in the groundwater suggests that biodegradation of PCE and/or TCE is occurring (Figure C4.2-1). Such biodegradation can be enhanced by the presence of the fuel hydrocarbons, which are present in the groundwater at the site (see Section C4.4). These fuel hydrocarbons could be a carbon source for indigenous microorganisms, a process discussed in Section 3 of Volume 1 of this report.

## Extent of Contamination

The lateral (transgradient) extent of halogenated non-aromatic VOCs in the groundwater south of Building 76 is characterized by the absence of VOCs in wells to the west and east of the plume (Figure C4.3-1). The lateral (downgradient) extent of the plume is indicated by only sporadic detections of low concentrations of cis-1,2-DCE (below the MCL) in well MW76-98-22. The upgradient extent of contamination is indicated by the relatively low concentrations of TCE (below the MCL) that have been detected in a well (MW78-97-20) located north of Building 76 (Figure C4.3-3); however, it is possible that contamination detected in this well originates from a separate source.

The extent of halogenated non-aromatic VOCs is also depicted on the hydrogeologic cross sections B-B' and F-F' (Figure C4.3-12 and Figure C4.3-13). The water table at the site is within the upper portion of the Orinda Formation. The vertical extent of contamination is shown

as being restricted to the upper few feet of the saturated zone, which conforms to the conceptual model for contaminant transport in groundwater described in Section C4.2.

## Trends in Contaminant Concentrations

MW76-1 is the only monitoring well in the Building 76 area that has been sampled for a sufficient period to allow assessment of temporal trends in concentrations of VOCs (Figure C4.3-14). Concentrations in MW76-1 have remained relatively constant since 1993.

## Potential Sources of Contamination

Potential sources for halogenated non-aromatic VOCs in the Building 76 Area include SWMUs and AOCs where organic solvents have reportedly been stored or used (LBNL, 1992d). The locations of these units are shown on Figure C4.3-15 and listed in the following table:

**SWMUs and AOCs in the Building 76 Area that Stored or Used Solvents**

| Unit Number | Unit Name |
|---|---|
| SWMU 4-2* | Building 76 Oil/Water Separator, Basin, and Sumps |
| SWMU 4-3* | Building 76 Motor Pool Collection Trenches and Sump |
| SWMU 4-4 | Building 76 Present and Former Waste Accumulation Area #1 |
| SWMU 4-6* | Building 76 Present and Former Waste Accumulation Area #3 |
| SWMU 4-7 | Building 76 Paint Shop Waste Recovery Unit |
| SWMU 4-8 | Building 76 Paint Shop Sink. |

* SWMUs and AOCs discussed in Section C3.

Potential releases from these units were evaluated in the RFA (LBNL, 1992d) and/or the RFI. The area of maximum VOC concentrations in groundwater south of Building 76 indicates that the primary source of the Building 76 VOC plume was related to Building 76 operations; however, the specific source has not been located. Of the units listed above, SWMU 4-3 is the most likely source because of its location relative to the plume and its potential for past release (Figure C4.3-15). Two concrete collection trenches collected overflows, incidental spills, and washdown water within the Building 76 motor pool area. The trenches were installed in 1964 at the time of motor pool construction. Only relatively low concentrations (<0.04 mg/kg) of halogenated VOCs have been detected in soil samples at the site. SWMU 4-3 is discussed in more detail in Section C3.2.

### *C4.3.2 Building 75/75A Area*

## Description of Contaminants

Groundwater in the Building 75/75A area is contaminated with solvent-related halogenated non-aromatic VOCs. East of Building 75A (MW75-96-20), the contamination appears to be the result of the degradation of PCE and/or TCE, with TCE and cis-1,2-DCE detected in the groundwater in FY99. Chloroform, 1,1-DCA, and PCE were detected in MW75-96-20 previously, and a relatively high concentration of cis-1,2-DCE (240 μg/L) was detected in a grab sample collected from the boring for lysimeter well SB75-96-1 (adjacent to MW75-96-20) in 1996. South of Building 75A (MW75-98-14), the contamination appears to be the result of the degradation of 1,1,1-TCA, with 1,1-DCE the primary contaminant detected in FY99. Chloroform, 1,1-DCA, and 1,1,1-TCA were also detected in the well in FY99.

TCE was the only halogenated non-aromatic VOC detected at a concentration above the MCL in FY99 (7.0 μg/L in well MW75-96-20: MCL = 5.0 μg/L).

## Extent of Contamination

The upgradient and transgradient extent of the contamination detected in groundwater east and south of Building 75A is characterized by the absence of VOCs in monitoring wells to the north (MW91-3), west (MW75-99-6 and MW75-99-8), east (MW91-5), southwest (MW75-98-15 and MW75-99-4), and southeast (MW75-92-23) of the building (Figure C4.3-1). The contaminants detected east of Building 75A (TCE and cis-1,2-DCE) and/or their degradation products have not been detected in MW75-98-14, south (downgradient) of the building, indicating the downgradient extent of this contamination. Concentrations of contaminants detected in MW75-98-14 have consistently decreased since the well was constructed in 1998. Chlorinated hydrocarbons were not detected in the most recent sample collected from this well in September 2000.

## Trends in Contaminant Concentrations

Monitoring wells MW75-97-5 and MW75-96-20 have been sampled for a sufficient period to assess temporal trends in concentrations of VOCs in the Buildings 75/75A area (Figure C4.3-14). No trends in concentrations are evident for either well. As discussed previously, low concentrations (below MCLs) of halogenated non-aromatic VOCs were initially detected south of Building 75A in MW75-98-14. Concentrations of these contaminants have decreased to non-detectable levels.

## Potential Sources of Contamination

The presence of cis-1,2-DCE east of the building suggests biodegradation of PCE and/or TCE. Potential sources for halogenated non-aromatic VOCs in the Building 75/75A Area include SWMUs and AOCs reported to have stored or used organic solvents (LBNL, 1992d). The locations of these units are shown on Figure C4.3-15 and listed in the following table. In addition, it is possible that the low concentrations of contaminants detected in MW75-98-14 were introduced during the construction and/or development of the well.

**SWMUs and AOCs in the Buildings 75/75A Area that Stored or Used Solvents**

| Unit Number | Unit Name |
|---|---|
| SWMU 3-4 | Building 69 Former Scrap Yard and Drum Storage Area |
| SWMU 3-6* | Building 75 Former Hazardous Waste Handling and Storage Facility |
| SWMU 3-8 | Building 75D UCB Hazardous Waste Handling Facility |

* SWMUs and AOCs discussed in Section C3

The Building 75 Former Hazardous Waste Handling and Storage Facility (SWMU 3-6) is located in the area of the groundwater contamination and the Building 69 Former Scrap Yard and Drum Storage Area (SWMU 3-4) is upgradient. Relatively low concentrations (<0.5 mg/kg) of halogenated non-aromatic VOCs have been detected in soil samples collected in the area of SWMU 3-6 (Section C3.1) and SWMU 3-4 (LBNL, 1998j). Investigation of sources for the groundwater contamination detected in the Building 75/75A area are continuing.

### *C4.3.3 Building 69A Area*

## Description of Contaminants

Monitoring well MW69-97-8 was installed in 1997 to help evaluate potential migration pathways for tritium contaminated groundwater in the Support Services Area. Cis-1,2-DCE (approximately 20 μg/L) was consistently detected in groundwater samples collected from the well. To investigate the source of the cis-1,2-DCE, eight soil gas probes were installed west of Building 69A in 1999. Temporary groundwater sampling point SB69A-99-1 was installed at the location where the highest soil gas readings were recorded. Cis-1,2-DCE has been detected in this well at a maximum concentration of 99 μg/L.

The groundwater contamination west of Building 69A consists primarily of cis-1,2-DCE. Low concentrations (below the MCL) of trans-1,2-DCE, 1,1,1-TCA, and vinyl chloride were also detected in groundwater samples collected from MW69-97-8 and/or SB69A-99-1 in FY99 and FY00. Low concentrations (below MCLs) of PCE, TCE, 1,1-DCE, and 1,1-DCA have been detected in MW69A-92-22 in this area previously. Maximum concentrations of VOCs detected above MCLs in FY99 and FY00 are shown in the following table. TPH-C/WO and TPH-D have also been detected in MW69-97-8 (Section C4.4).

**Maximum Concentrations of Halogenated non-aromatic VOCs Detected at Concentrations Above MCLs in FY99 and FY00 in the Building 69A Area**

| Chemical | Well | Maximum Concentration (μg/L) | Maximum Contaminant Level (MCL) (μg/L) |
|---|---|---|---|
| Vinyl chloride | SB69A-99-1 | 1.6 | 0.5 |
| cis-1,2-DCE | SB69A-99-1 | 99 | 6 |

The presence of cis-1,2-DCE and vinyl chloride suggests biodegradation of PCE and/or TCE (Figure C4.2-1). Such biodegradation can be enhanced by the presence of fuel hydrocarbons, which are present in the groundwater in this area (see Section C4.4). These fuel hydrocarbons could be a carbon source for indigenous microorganisms, a process discussed in Volume 1 Section 3 of this report.

## Extent of Contamination

The lateral extent of contamination (cis-1,2-DCE) appears to be confined to a limited area west and southwest of Building 69A(Figure C4.3-1). Cis-1,2-DCE was detected in FY99 in monitoring well MW69-97-8 and temporary groundwater sampling point SB69-99-1. Cis-1,2-DCE has also been detected in slope stability wells SSW4-130 and SSW16-130 when they were last sampled in May 1997 (Table C4.3-4 and Figure C4.1-1), and in the effluent from hydraugers 77-02-05 and 77-02-06 (Table C4.3-3). The two slope stability wells have been properly destroyed to prevent infiltration of contaminated surface water and were replaced by two properly constructed groundwater monitoring wells.

The upgradient extent of the contamination is characterized by the absence of VOCs in monitoring wells to the north and northwest of Building 69A (MW91-6 and MW75-92-23). The transgradient extent of the contamination is characterized by the absence of VOCs in monitoring wells to the east (MW69A-92-22) and west (MW75-97-7) of the contamination, and sampling results from hydraugers southeast of the contamination. The downgradient extent is characterized by the absence of VOCs in slope stability wells SSW19-130, SSW20-130, and SSW21-130 (sampled in 1994). The extent of 1,1,1-TCA (Figure C4.3-7) and vinyl chloride (Figure C4.3-9) are much more limited than that of cis-1,2-DCE.

The extent of halogenated non-aromatic VOCs in the Building 69A area is also depicted on the eastern portion of hydrogeologic cross section B-B' (Figure C4.3-12). The vertical extent of contamination is shown as being restricted to the colluvium and the upper few feet of the Orinda Formation. This depiction conforms to the conceptual model described above, and is supported by the analytical results. The groundwater contamination in this area has been primarily detected in SB69A-99-1, which is screened in fill, and MW69-97-8, which is screened in both colluvium and the Orinda Formation. Contaminants have either not been detected or detected sporadically in adjacent wells screened entirely in the Orinda Formation.

## Trends in Contaminant Concentrations

MW69-97-8 and MW69A-92-22 are the only monitoring wells sampled for a sufficient period to assess temporal trends in concentrations of VOCs. Except for PCE, concentrations of VOCs detected in MW69A-92-22 decreased to trace levels (< 1 μg/L) within one year of well installation in 1993. Low concentrations of PCE (below the MCL) have been sporadically detected in the well since 1994. Concentrations detected in MW69-97-8 have remained relatively constant (approximately 20 μg/L of cis-1,2-DCE) since well installation in 1998 (Figure C4.3-14).

## Potential Sources of Contamination

Potential sources for halogenated non-aromatic VOCs in the Building 69A Area include SWMUs and AOCs reported to have stored or used organic solvents (LBNL, 1992d). The locations of these units are shown on Figure C4.3-15 and listed in the following table.

**SWMUs and AOCs in the Building 69 Area that Stored or Used Solvents**

| Unit Number | Unit Name |
|---|---|
| SWMU 3-1 | Building 69A Hazardous Waste Handling Facility. |
| SWMU 3-5 | Building 69A Storage Area Sump |
| AOC 3-1 | Building 69A Hazardous Materials Storage and Delivery Area. |
| AOC 3-2 | Building 69/75 Fire Drill Area. |

* SWMUs and AOCs discussed in Section C3

Potential releases from these units were evaluated in the RFA (LBNL, 1992d) and/or the RFI. The most likely source of the groundwater contamination was leakage from a pipeline in the Building 69A Hazardous Materials Storage and Delivery Area (AOC 3-1) that drains to the Building 69A Storage Area Sump (SWMU 3-5). The sump provided containment for fluids that might have been spilled in the Building 69A Hazardous Materials Storage and Delivery Area (AOC 3-1). It also acted as a release control for the Building 69A Hazardous Waste Handling Facility (SWMU 3-1) before separate release controls were installed in 1991. The pipe is

constructed of 4" cast iron. The sump is approximately 6-feet long by 4- feet wide and has a 200-gallon capacity and was probably installed in 1967 when Building 69 was built.

A dislocation was observed in one of the sump drainpipes and repaired in 1987 (LBNL, 1992d). During the RFA, shallow soil-gas samples were collected to help assess whether chemicals handled in SWMU 3-1 or AOC 3-1 had been released to the environment. The highest VOC concentrations in the soil gas were found adjacent to the repaired dislocation of the pipe. PCE (maximum 2 mg/kg) and TCE (maximum 0.008 mg/kg) were detected in RFA soil samples collected at this location. The results indicated that the pipe was a probable source of release. In 1992, monitoring well MW69A-92-22 was installed at this location to assess if groundwater had been impacted. As described above, except for PCE, concentrations of VOCs detected in MW69A-92-22 decreased to trace levels (< 1 μg/L) within one year of well installation in 1993. Low concentrations of PCE (below the MCL) have been sporadically detected in the well since 1994.

### *C4.3.4 Building 77 Area*

## Description of Contaminants

Cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE, and 1,1-DCA have been detected in MW91-2 every quarter the well has been sampled, with the concentration of cis-1,2-DCE above the MCL every quarter. Trans-1,2-DCE, 1,1-DCE, and 1,1-DCA have been below the MCL since June 1993. Except for anomalous detections of PCE and TCE in March 1996 and PCE and 1,1,1-TCA in March 2000, these are the only VOCs that have been detected in the well. The presence of cis-1,2-DCE, trans-1,2-DCE and possibly 1,1-DCE is probably the result of biodegradation of PCE and/or TCE. The presence of 1,1-DCA, and possibly 1,1-DCE, is probably the result of biodegradation of 1,1,1-TCA (Figure C4.2-1).

In addition, chloroform (2.2 μg/L) was detected in MW77-97-11 once in May 1999. Chloroform was not detected in subsequent samples. The presence of chloroform was probably the result of sample contamination.

## Extent of Contamination

The lateral extent of contamination is limited to the area of MW91-2, south of Building 77 (Figure C4.3-1). The transgradient extent of the contamination is characterized by the absence of VOCs in monitoring wells a short distance to the east (MW77-94-6) and west (MW77-94-5) of MW91-2. VOCs have not been detected in either of these wells since July 1996. The downgradient extent of contamination is characterized by the absence of VOCs in monitoring well MWP-9 to the south. VOCs have not been detected in this well since July 1997.

MW91-2 is screened in fill and the Orinda Formation. Based on the conceptual model presented above, the vertical extent of contamination should be limited primarily to the fill and the upper few feet of the Orinda Formation.

## Trends in Contaminant Concentrations

MW91-2 is in the source area of the groundwater contamination and since February 1997, the only well monitoring this area in which halogenated non-aromatic VOCs have been detected. Concentrations of both total halogenated non-aromatic VOCs and the individual chemicals (cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE, and 1,1-DCA) detected in MW91-2 have shown a decreasing trend since 1992. The maximum concentrations of total halogenated non-aromatic VOCs detected in MW91-2 was 60.7 μg/L in November 1992, and the minimum 11.2 μg/L in September 1998. The concentration of cis-1,2-DCE has decreased from approximately 20 μg/L to less than 10 μg/L, slightly above the MCL (6 μg/L).

## Potential Sources of Contamination

Potential sources for halogenated non-aromatic VOCs in the Building 77 Area include SWMUs and AOCs reported to have stored or used organic solvents (LBNL, 1992d). The locations of these units are shown on Figure C4.3-15 and listed in the following table:

**SWMUs and AOCs in the Building 77 Area that Stored or Used Solvents**

| Unit Number | Unit Name |
|---|---|
| SWMU 5-4* | Building 77 Plating Shop Floor and Sump |
| SWMU 5-6 | Building 77 Waste Accumulation Area |
| SWMU 5-7 | Building 77G Waste Accumulation Area |
| SWMU 5-10 | Building 77 Present and Former Yard Decontamination Area |
| SWMU 5-11 | Building 77 Former Yard Solution Bath Area |
| AOC 5-3 | Building 79 Hazardous Materials Storage Area #2 |
| AOC 5-4* | Building 77 Sanitary Sewer System |

* SWMUs and AOCs discussed in Section C3

Potential releases from these units were evaluated in the RFA (LBNL, 1992d) and/or the RFI. Of the units listed above, the Building 77 Sanitary Sewer System (AOC 5-4) was considered the most likely source of the groundwater contamination, based on its location relative to the contamination (Figure C4.3-15); however, soil and soil-gas sampling conducted along the sewer line could not identify a source area.

### *C4.3.5 Building 75B Area*

## Description of Contaminants

Low concentrations (below the MCL) of 1,1-DCA and 1,1-DCE have been detected in MW75-97-5 every quarter the well has been sampled. No other VOCs have been detected. The presence of 1,1-DCA and 1,1-DCE is probably the result of biodegradation of 1,1,1-TCA (Figure C4.2-1). TPH-C/WO has also been detected in MW75-97-5 (Section C4.4).

## Extent of Contamination

The lateral extent of contamination is limited to the area of MW75-97-5, southeast of Building 75B (Figure C4.3-1). The transgradient extent of the contamination is characterized by the absence of VOCs in monitoring wells a short distance to the east (MW75-97-6) and west (MW75B-92-24) of MW75-97-5. Except for a trace concentration (<1 μg/L) of 1,1,1-TCA in MW75-97-6 in August 1997 and anomalous detections of three VOCs in MW75B-92-24 in June 1993, VOCs have not been detected in either of these wells. The downgradient extent is

characterized by the absence of VOCs in MW77-97-9, north of Building 77. The only VOC detected in this well was a trace concentration of 1,1-DCA in August 1997.

MW75-97-5 is screened in colluvium and the Orinda Formation. Based on the conceptual model presented above, the vertical extent of contamination should be limited primarily to the colluvium and the upper few feet of the Orinda Formation.

## Trends in Contaminant Concentrations

MW75-97-5 has only been sampled since August 1998. No temporal trend is evident in concentrations of VOCs in the well (Figure C4.3-14).

## Potential Sources of Contamination

Potential sources for halogenated non-aromatic VOCs southeast of Building 75B include SWMUs and AOCs reported to have stored or used organic solvents (LBNL, 1992d). The locations of these units are shown on Figure C4.3-15 and listed in the following table.

**SWMUs and AOCs in the Buildings 75B Area that Stored or Used Solvents**

| Unit Number | Unit Name |
|---|---|
| SWMU 3-4 | Building 69/75A Former Scrap Yard and Drum Storage Area |
| SWMU 3-6* | Building 75 Former Hazardous Waste Handling and Storage Facility |
| SWMU 3-8 | Building 75D UCB Hazardous Waste Handling Facility |

* SWMUs and AOCs discussed in Section C3

The source of the contamination detected in MW75-97-5 is not known. Concentrations of VOCs detected in the well have been below the MCL.

### *C4.3.6 Other Areas Where Halogenated Non-Aromatic VOCs Were Previously Detected*

Halogenated non-aromatic VOCs were also detected in other monitoring wells in the Support Services Area prior to FY99 (Table C4.3-1). The concentrations of VOCs detected were

generally below MCLs. Those wells in which VOCs have been detected, but not since August 1997, are listed in the following table.

**Monitoring Wells in Which Halogenated Non-Aromatic VOCs Have Not been Detected Since August 1997**

| Building 75/69 Area | Building 76 Area | Building 77 Area |
|---|---|---|
| MW91-3 | MW76-93-7 | MW77-92-10 |
| MW91-5 | | MW77-93-8 |
| MW91-6 | | MW77-94-5 |
| MW75-92-23 | | MW77-94-6 |
| MW75B-92-24 | | MW77-97-9 |
| MW76-93-6 | | MWP-9 |
| MW75-97-6 | | |

The detection of halogenated non-aromatic VOCs in MWP-9 between February 1996 and February 1997 was attributed to cross contamination during sampling.

In addition to slope stability wells SSW4-130 and SSW16-130, which are discussed above, halogenated non-aromatic VOCs were detected in slope stability wells SSW5-130 (1,1-DCA and 1,1-DCE), SSW9-130 and SSW13-130 (cis-1,2-DCE), and SSW15-130 (chloroform). These slope stability wells have all been properly destroyed to prevent the infiltration of surface water.

Samples collected in 1993 of effluent from hydrauger 77-01-02, which drains the slope south of Building 75B, contained 1,1-DCA and 1,1-DCE. This hydrauger has not been sampled since that time because the flow was cut off by construction of a slope retaining system.

## *C4.4 Petroleum Hydrocarbons, SVOCs, PCBs and Metals in Groundwater*

### *C4.4.1 Petroleum Hydrocarbons*

Two general evaluation methods were used to assess potential releases of fuels or lubricants to groundwater:

1. Groundwater samples collected near SWMUs and AOCs that managed fuel hydrocarbon products, petroleum lubricants, or petroleum wastes were analyzed for TPH and/or Total Oil and Grease (Table C4.4-1; Figure C4.4-1).

2. Samples collected from all groundwater monitoring wells, temporary groundwater sampling points, and hydraugers have routinely been analyzed for VOCs by EPA method 8260. The target analytes for this method include several classes of organic compounds, including non-aromatic halogenated hydrocarbons (e.g., PCE, TCE, etc.), monoaromatic halogenated hydrocarbons (e.g., 1,2 dichlorobenzene), monoaromatic non-halogenated hydrocarbons (e.g., benzene), and polyaromatic non-halogenated hydrocarbons (e.g., naphthalene and other PAHs). The first class of compounds (non-aromatic hydrocarbons) is commonly derived from industrial solvents, which are discussed in detail in the Section C4.3. The last three classes of compounds (all three comprise various aromatic hydrocarbons) include constituents that are commonly present in fuel products. For this reason, compounds in these three classes were evaluated separately from other VOCs. These data are presented in Tables C4.3-1 (monitoring wells), C4.3-2 (temporary groundwater sampling points), C4.3-3 (hydraugers), and C4.3-4 (slope stability wells); and on Figure C4.4-2.

Petroleum hydrocarbons have been detected in groundwater in a number of wells in the Support Services Area. Wells in which TPH and aromatic hydrocarbons have been detected are shown on Figures C4.4-1 and C4.4-2, respectively. The locations of SWMUs and AOCs that managed petroleum hydrocarbons, and are therefore potential sources for the groundwater contamination, are included on the figures.

## Diesel- and Gasoline- Range Hydrocarbons in Groundwater South of Building 76

Diesel- and gasoline- range hydrocarbons have been detected south of Building 76, in wells near the Former and Present Diesel (AOC 4-2 and AOC 4-4) and Gasoline (AOC 4-1 and AOC 4-3) USTs (Figures C4.4-1). TPH-D (980 µg/L maximum) was detected in three temporary groundwater sampling points (W76-97-3, W76-97-4, and W76-97-5), that were installed in the backfilled excavation for the former USTs (Table C4.4-1). TPH-D and TPH-G were detected in MW76-1, downgradient from the former UST site. In addition, a sample collected from soil boring SB76-95-3 in June 1995 contained TPH-D (1,500 µg/L) and TPH-G (790 µg/L). SB76-95-3 was located adjacent to the south end of the backfilled collection trench, near the southeast corner of the excavation for the former USTs. TPH-D has also been occasionally detected in MW76-93-7 west of MW76-1.

Trace concentrations (approximately 1 µg/L or less) of aromatic hydrocarbons were detected in MW76-1 prior to 1997 (Table C4.3-1). Aromatic hydrocarbons and non-halogenated

non-aromatic hydrocarbons have not been detected in the other wells in which TPH has been detected.

The source of the diesel and gasoline range contamination is most likely the Former Diesel and Gasoline USTs (AOC 4-2 and AOC 4-1).

### Diesel- and Crude/Waste Oil- Range Hydrocarbons

In addition to the Building 76 area, diesel- and crude/waste oil-range hydrocarbons have been detected in five scattered wells at the northern end (MW91-4 and MW91-5) and southern end (MW76-93-6, MW75-97-5, and MW69-97-8) of the Building 75/69 area (Figure C4.4-1 and Table C4.4-1). Except for benzene in MW91-4, aromatic and non-halogenated hydrocarbons have only been detected during a single sampling event in any of these wells (Table C4.3-1). The source(s) for this groundwater contamination have not been identified.

### Aromatic and Non-Halogenated Hydrocarbons

Aromatic and non-halogenated hydrocarbons were detected more than once in only two wells in the Support Services Area: MW76-1 south of Building 76 and MW91-4 east of Building 75A (Table C4.3-1, Figure C4.4-2). As discussed above, aromatic hydrocarbons have not been detected in MW76-1 since December 1996. Benzene has been detected in MW91-4 every quarter the well has been sampled but one since October 1992, with concentrations ranging from 3.6 to 98 μg/L (MCL = 1 μg/L). The source of the benzene is not known. MW91-4 is screened approximately 100 feet below the water table and benzene has not been detected in the two adjacent wells screened near the water table (MW75-96-20 and MW75-99-7).

## *C4.4.2 Semi-Volatile Organic Compounds (SVOCs) in Groundwater*

Samples collected from several Support Services Area monitoring wells in 1994 (and MW75-96-20 in 1997) were analyzed for SVOCs (Table C4.4-2 and Figure C4.4-3). The only SVOC detected was bis(2-ethylhexyl)phthalate (DEHP). DEHP was also detected in 35 of the 79 wells sampled site-wide during 1994, and in five of the seven field (rinse) blanks. No DEHP was detected in laboratory QC samples. Since DEHP is a common laboratory contaminant, the

presence of DEHP in these samples is interpreted to have resulted from sample contamination. The results are therefore not considered representative of groundwater contamination.

### *C4.4.3 Polychlorinated Biphenyls (PCBs)in Groundwater*

SWMUs and AOCs where PCBs were stored or used and areas of PCB contaminated soil in the Support Services Area are shown on Figure C4.4-4. PCBs were detected in soil at the following locations:

- in the yard area of the Building 75 Former Hazardous Waste Handling and Storage Facility (SWMU 3-6) (west of Building 75 near the J Pad) and near the southeast corner of Building 75
- in Building 69A adjacent to a pipeline that drains to the Building 69A Storage Area Sump (SWMU 3-5)
- Grizzly Peak Electrical Substation.

Of the locations where PCBs were detected in soil in the Support Services Area, PCBs were detected at the highest concentrations and over the widest area at the Building 75 Former Hazardous Waste Handling and Storage Facility (SWMU 3-6). The magnitude and extent of contamination detected in the soil at SWMU 3-6 are discussed in Section C3.1. PCBs were detected at a maximum concentration of 48 mg/kg, well above the PRG for residential soil (0.2 mg/kg) and the TSCA cleanup level for soil in high occupancy areas (1 mg/kg).

As discussed in Section C3.1, LBNL performed transport and fate modeling and modeling of partitioning of PCBs to assess if groundwater in the area of Building 75 could potentially be impacted by the PCBs in the soil. The results of the modeling indicated that groundwater would not be impacted. To confirm those results, monitoring wells were installed in the areas of maximum soil contamination (MW75-99-6, MW75-99-7, and MW75-99-8) and in the area downgradient of the maximum soil contamination (MW75-99-4) (Figure C4.4-4). PCBs were not detected in groundwater samples collected from these four wells and three other wells in the area of the soil contamination (MW75-96-20, MW75-98-14, and MW75-98-15) (Table C4.4-3).

PCBs (0.2 mg/kg maximum) were also detected in two soil samples collected along the pipeline in the Building 69A Hazardous Materials Storage and Delivery Area (AOC 3-1) that drains to the Building 69A Storage Area Sump (SWMU 3-5) and in two soil samples (0.018 mg/kg maximum) collected at the Grizzly Peak Electrical Substation in 1998. The maximum concentration detected (0.2 mg/kg) is at the PRG for residential soil and well below the TSCA self implementing cleanup level for soil in high occupancy areas.

### *C4.4.4 Metals in Groundwater*

Initial groundwater samples collected after installation of each groundwater monitoring well are analyzed for metals, and subsequently sampled in accordance with RWQCB requirements. Metals were detected at concentrations above MCLs during more than one quarter in only one monitoring well (selenium in MW69-97-21) (Table C4.4-4). In addition, arsenic was detected above the MCL in MW75-99-8, the only quarter the well has been sampled. The locations of these wells are shown on (Figure C4.4-5). Concentrations of metals above MCLs initially detected in the other wells were well below MCLs in subsequent samples. The 1992 and 1993 data are suspect since anomalously high concentrations of several metals were reported at that time that were not supported by results from subsequent samples.

MW69-97-21 is located on the steep slope east of Building 69 (Figure C4.4-5), upgradient from any developed area, and is not near any potential sources of selenium. Therefore, the elevated concentrations of selenium detected are probably naturally occurring. MW75-99-8 was only sampled in February 2000, just after well installation. Additional sampling is required to confirm the elevated concentration of arsenic detected in this well.

## *C4.5 Potential Migration of Contaminants to Surface Water*

The Support Services Area is located within the Strawberry Canyon Watershed (Figure C4.5-1). Surface runoff and storm drain flow within the Strawberry Canyon Watershed drain toward tributaries of Strawberry Creek: Chicken Creek and No Name Creek. Some minor surface runoff from the extreme southwestern part of the area may also flow to Ten-Inch Creek; however, this creek receives the major portion of its runoff from the Old Town Area. In

addition, some groundwater flowing from the Support Services Area may be intercepted by these three creeks. Surface water samples have been routinely collected from these creeks and analyzed for VOCs and metals. In addition, surface water and sediment samples were therefore collected from Chicken Creek and No Name Creek and analyzed for chemicals of potential concern from upgradient sources. Also, a sediment sample was collected in 1993 from a storm drain in the Building 75/69 area prior to the collection of the creek samples.

Surface water sampling results for organics and metals are included in Tables C4.5-1 and C4.5-3, respectively. Sediment sampling results for organics and metals are included in Tables C4.5-2 and C4.5-4. Surface water and sediment sampling locations are shown on Figure C4.5-1 and Figure C4.5-2, respectively. The potential impact to the environment from contaminants detected in surface water and sediment will be evaluated in the ecological risk assessment.

### *C4.5.1 Chicken Creek*

Surface water samples have been collected from Chicken Creek and analyzed for VOCs, SVOCs, and metals. Surface water samples were primarily collected at the site perimeter. No VOCs or SVOCs were detected. Metals were either not detected or detected at concentrations well below MCLs.

Sediment samples have been collected from Chicken Creek and analyzed for VOCs, SVOCs, TPH-D, TPH-G, PAHs, PCBs, selected pesticides, and metals. The pesticides were selected for analysis based on detection in soil in the Support Services Area. The only VOC detected was p-isopropyltoluene (0.0058 mg/kg) in one of six samples. SVOCs were not detected. TPH quantified as 'oil' (within the diesel range) (63 mg/kg) was detected. Two PAHs, benzo(a)pyrene (0.075 mg/kg) and chrysene (0.028 mg/kg) were detected in one sediment sample collected in January 1998. PAHs were not detected in a subsequent sediment sample collected from the same location in February 1998; however, a trace concentration of PCBs 0.014 mg/kg was detected. The selected pesticides were not detected.

The detection of oil was probably the result of runoff from surface streets. The PCBs and PAHs detected may have also been the result of surface runoff. PCBs and three different PAHs

(fluoranthene, phenanthrene, and pyrene) had been detected in a sediment sample collected in 1993 from a storm drain in the Building 75/69 area (Figure C4.5-2; Table C4.5-2). The potential impact to the environment from contaminants detected in surface water and sediment will be evaluated in the ecological risk assessment.

### *C4.5.2 No-Name Creek*

Surface water samples have been collected from No Name Creek and analyzed for VOCs and metals. Samples were collected near the location where the creek enters the storm drain system along Strawberry Creek. No VOCs were detected. Metals were either not detected or detected at concentrations well below MCLs.

Sediment samples have been collected from No Name Creek and analyzed for SVOCs PCBs, and metals. Samples were collected from several locations along the creek south of the LBNL boundary (Figure C4.5-2). Neither PCBs nor SVOCs were detected. Metals were either not detected or detected within LBNL background levels for soil.

### *C4.5.3 Ten-Inch Creek*

Surface water samples have been collected from Ten-Inch Creek and analyzed for VOCs and metals. Samples were collected near the location where the creek enters the storm drain system along Strawberry Creek. No VOCs were detected. Metals were all detected at concentrations below MCLs.

Sediment samples have been collected from Ten-Inch Creek and analyzed for SVOCs and metals. Samples were collected from several locations along the creek south of the LBNL boundary (Figure C4.5-2). No SVOCs were detected. Metals were detected at concentrations within LBNL background levels for soil

## C5 INDOOR AIR SAMPLING

Ambient air samples were collected inside buildings in the Support Services Area and analyzed for VOCs, to provide data that will be required for the human health risk assessment.

Twenty-four hour indoor air samples were collected in March 1999 at four locations in the Support Services Area. In addition, a background sample was collected from the second floor of Building 90. Sampling locations are shown on Figure C5.1-1. The following seven chemicals were selected for indoor air monitoring:

- PCE
- TCE
- benzene
- 1,1-DCE
- carbon tetrachloride
- chloroform
- vinyl chloride.

These chemicals are among the most commonly detected in soil gas and they have the most potential to present a health risk should their vapors infiltrate into buildings. Concentrations of analytes detected are listed in the following table. Also listed in the table are the California OSHA Permissible Exposure Limits (PELs). Carbon tetrachloride was detected in samples collected from Buildings 75A, 76, and 77 at similar concentrations as detected in the background samples from Building 90. Benzene was detected in samples collected from Buildings 69, 75A, and 77 at similar concentrations as detected in the background samples. Elevated concentrations of benzene, TCE, and PCE were detected in duplicate samples collected from Building 76. Building 76 is an active motor pool area and fuel station. All concentrations are below California Occupational Safety and Health Administration (Cal/OSHA) Permissible Exposure Limits (PELs).

**Indoor Air Sample Results, Support Services Area**

| | | Concentration (ppbv) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **1,1-DCE** | **Benzene** | **chloroform** | **carbon tetrachloride** | **TCE** | **PCE** | **Vinyl chloride** |
| | **PELs Action Level** | 1000 | 1000<br>500 | 2000 | 2000 | 25,000 | 25,000 | 1000 |
| ***Sample No.*** | ***Building No.*** | | | | | | | |
| IA69-99-1 | 69 | <0.033 | 0.74 | <0.033 | <0.033 | <0.16 | <0.082 | <0.13 |
| IA75A-99-1 | 75 | <0.031 | 0.45 | <0.031 | 0.061 | <0.16 | <0.078 | <0.12 |
| IA76-99-1 | 76 | <0.030 | 2.1 | <0.030 | 0.076 | 0.22 | 9.4 | <0.12 |
| IA76-99-1 duplicate | 76 | <0.061 | 2.3 | <0.061 | 0.065 | <0.30 | 10 | <0.24 |
| IA77-99-1 | 77 | <0.034 | 0.80 | <0.034 | 0.059 | <0.17 | <0.086 | <0.14 |
| IA90-99-1 Background Sample | 90 | <0.03 | 0.52 | 0.064 | 0.071 | <0.15 | <0.076 | <0.12 |

PEL: California OSHA Permissible Exposure Limit
<0.03: Not detected (showing detection limit in ppbv)
NA: Not analyzed

# C6. SUMMARY AND CONCLUSIONS

## *C6.1 Status of Solid Waste Management Units and Areas of Concern*

The status of SWMUs and AOCs in the Support Services Area is listed in Table C1-1. During the RFI, LBNL submitted requests for No Further Action (NFA) or No Further Investigation (NFI) status to the regulatory agency with oversight responsibility for the specific SWMU or AOC, in accordance with procedures approved by the DTSC. The requests provided the following information, as appropriate:

- soil investigation results that provided information on the potential for past releases and on the magnitude and extent of contamination.
- groundwater sampling data pertaining to potential migration of soil contaminants to these media.
- groundwater, surface water, and sediment sampling data pertaining to potential migration of contaminants to these media.

Except for groundwater AOCs and the National Tritium Labeling Facility (NTLF) (SWMU 3-7), a radiological unit, all designated SWMUs and AOCs in the Support Services area have been approved for either NFA or NFI Status. No further site characterization is required for SWMUs and AOCs approved for either NFA or NFI status; however, SWMUs and AOCs approved for NFI status will be included in the site wide risk assessment to be conducted as part of the Corrective Measures Studies (CMS) phase of the RCRA Corrective Action Program (CAP). Units that have been approved for NFA status will not be included in the CMS. A request for NFI or NFA status for the NTLF will be submitted to the DOE when investigations at that unit have been completed.

## *C6.2 Groundwater Contamination*

The primary contaminants detected in groundwater in the Support Services Area have been solvent related halogenated non-aromatic VOCs and fuel hydrocarbons. The most widespread of these are the VOCs, which are present in several relatively small, apparently isolated areas (Figure C4.1-1). Concentrations of halogenated non-aromatic VOCs are currently above the MCL in five monitoring wells in the Support Services Area. Cis-1,2 (30 μg/L maximum in FY99) is above the MCL (6 μg/L) in MW91-2, south of Building 77; in MW76-1, south of Building 76; and in MW69-97-8, west of Building 69A. TCE (15 μg/L maximum in FY99) is above the MCL (5 μg/L) in MW75-96-20, east of Building 75A and in MW76-98-21, south of Building 76. The solvent contaminated groundwater immediately south of Building 76 has been designated as a groundwater plume AOC (AOC 4-5 - Building 76 Solvent Contaminated Groundwater). The other areas of groundwater contamination have not been designated as AOCs.

Areas of halogenated non-aromatic contamination in groundwater in the Support Services Area were evaluated for the following criteria:

- the sources area for AOC 4-5 has been located in the area south of Building 76.
- the magnitude and extent of contamination have been characterized.

LBNL is continuing to assess sources for the other non-AOC groundwater contamination detected in the Support Services Area. Based on the conceptual model presented in Section C4.2, the lateral and vertical extent of groundwater contamination in the Support Services Area is limited primarily to the colluvium and fill, and to a limited extent the Orinda Formation. The model is supported by analytical results from wells near Building 69A, where the maximum concentrations of groundwater contaminants have been detected in wells screened in fill and colluvium, and contaminants have not been detected in adjacent wells that are screened entirely in the Orinda Formation.

LBNL will continue to sample groundwater monitoring wells in accordance with requirements of the RWQCB. The purpose of this sampling is to monitor the potential migration of contaminants and assess the stability of areas of groundwater contamination.

### *C6.2.1 Building 76 Solvent Contaminated Groundwater (AOC 4-5)*

## Source Identification

The Building 76 Motor Pool Collection Trenches and Sump (SWMU 4-3) is the most likely source of the groundwater contamination based on its location relative to the plume and its potential for past release (Figure C4.3-15). Only relatively low concentrations (<0.04 mg/kg) of halogenated VOCs have been detected in soil samples at the site.

Petroleum hydrocarbons (primarily TPH-D) have been detected in groundwater in the same area as the halogenated non-aromatic hydrocarbons. The Former Diesel (AOC 4-2) and Gasoline (AOC 4-1) USTs were the source for this contamination.

## Plume Characterization

The lateral (transgradient) extent of halogenated non-aromatic VOCs in the groundwater south of Building 76 is characterized by the absence of VOCs in wells to the west and east of the plume (Figure C4.3-1). The lateral (downgradient) extent of the plume is indicated by only sporadic detections of low concentrations of cis-1,2-DCE (below the MCL) in well MW76-98-22. The upgradient extent of contamination is indicated by the relatively low concentrations of

TCE (below the MCL) that have been detected in monitoring well MW78-97-20, located north of Building 76. The maximum concentrations of VOCs detected in wells monitoring this plume in FY99 were 15 μg/L of TCE, 8.5 μg/L of cis-1,2-DCE, and 1.4 μg/l of chloroform.

## Plume Stability and Potential Migration of Contaminants

The plume appears to be stable, in that contaminant concentrations detected in MW76-1 have remained relatively constant over several years of monitoring (Figure C4.3-14). In addition, contaminants have only been detected sporadically in the downgradient monitoring well.

### *C6.2.2 Building 75/75A Area Groundwater Contamination*

## Source Identification

The different suites of chemicals detected in groundwater east and south of Building 75A indicates at least two separate sources for the contamination (Figure C4.2-1). The contamination east of Building 75A may be related to former operations at the Building 75 Former Hazardous Waste Handling and Storage Facility (SWMU 3-6); however, only relatively low concentrations (<0.5 mg/kg) of halogenated non-aromatic VOCs, have been detected in soil samples collected in the area of SWMU 3-6. The low concentrations of contaminants initially detected south of Building 75A may have been the result of cross contamination.

## Groundwater Characterization

The upgradient and transgradient extent of the contamination detected in groundwater east and south of Building 75A is characterized by the absence of VOCs in monitoring wells to the north, west, east, southwest, and southeast of the building (Figure C4.3-1). The contaminants detected east of Building 75A (TCE and cis-1,2-DCE) and their degradation products have not been detected in MW75-98-14, south (downgradient) of the building, indicating the downgradient extent of this contamination. The presence of cis-1,2-DCE suggests

biodegradation of PCE and/or TCE is occurring. Concentrations of contaminants detected in MW75-98-14, south of Building 75A, have decreased to non detectable levels.

### *C6.2.3 Building 69A Area Groundwater Contamination*

## Source Identification and Removal

Based on the data collected from soil, soil gas and groundwater sampling, the western end of Building 69A appears to be the source area for the groundwater contamination. The most likely source was leakage from a pipeline in the Building 69A Hazardous Materials Storage and Delivery Area (AOC 3-1) that drains to the Building 69A Storage Area Sump (SWMU 3-5). The pipe was repaired.

## Groundwater Characterization

The lateral extent of contamination appears to be confined to a limited area west and southwest of Building 69A(Figure C4.3-1). The upgradient extent of the contamination is characterized by the absence of VOCs in monitoring wells to the north and northwest of Building 69A. The transgradient extent of the contamination is characterized by the absence of VOCs in monitoring wells to the east and west of the detected contamination, and sampling results from hydraugers southeast of the contamination. The downgradient extent is characterized by the absence of VOCs in slope stability wells downgradient of the site. The presence of cis-1,2-DCE and vinyl chloride suggests biodegradation of PCE and/or TCE is occurring. Such biodegradation can be enhanced by the presence of fuel hydrocarbons, which are present in the groundwater in this area.

### *C6.2.4 Building 77 Area Groundwater Contamination*

## Source Identification

The source of the groundwater contamination has not been identified; however, based on the location of the contamination, the source may have been an abandoned sewer located on the south side of Building 77.

## Groundwater Characterization

The lateral extent of contamination is limited to the area of MW91-2, south of Building 77 (Figure C4.3-1). The transgradient extent of the contamination is characterized by the absence of VOCs in monitoring wells a short distance to the east and west of MW91-2. VOCs have not been detected in either of these wells since July 1996. The downgradient extent of contamination is characterized by the absence of halogenated non-aromatic VOCs in monitoring well MWP-9 to the south.

### *C6.2.5 Building 75B Area Groundwater Contamination*

## Source Identification

The source of the contamination detected in groundwater southeast of Building 75B is not known. Concentrations of halogenated non-aromatic VOCs detected have been below MCLs.

## Groundwater Characterization

The lateral extent of contamination is limited to the area of MW75-97-5, southeast of Building 75B (Figure C4.3-1). The transgradient extent of the contamination is characterized by the absence of VOCs in monitoring wells a short distance to the east and west of MW75-97-5. The downgradient extent is characterized by the absence of halogenated non-aromatic VOCs in MW77-97-9, to the south. The only VOC detected in this well was a trace concentration of 1,1-DCA in August 1997.